

Best Products of 1997: **EDITORS' CHOICE AWARDS**

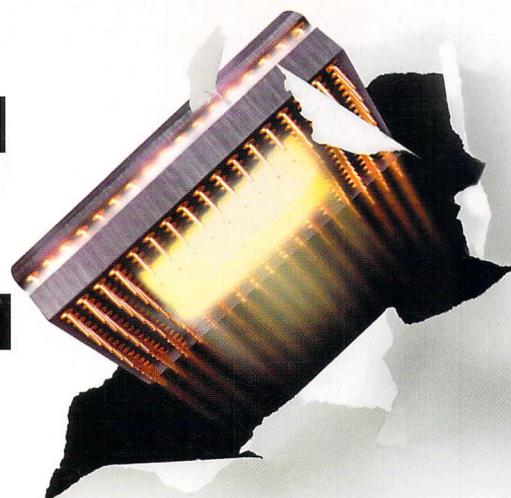
BYTE

THE FUTURE OF INFORMATION TECHNOLOGY TODAY DECEMBER 1997 www.byte.com

**SPECIAL 9 page
CHIP ANALYSIS**

BEYOND PENTIUM III

Step aside x86,
hello **EPIC**, the radical
new technology
inside **Intel's Merced**
Here's how it will
improve computing



9 NETWORK COMPUTERS
COMPARED:
\$1300 NEOWARE TOPS NCs



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NetFRAME MV5000

MICRON NETFRAME® LV2000 SERVER

Intel 233MHz Pentium II processor w/ECC
32MB ECC SDRAM
2GB Ultra-Wide SCSI-3 hard drive
NOS Support (3 incident resolutions/1st year), 7x24

STANDARD FEATURES

Single or dual Intel Pentium II processors
512KB integrated L2 cache in SEC package
ECC, SDRAM (4 DIMM slots)
5 expansion slots: 4PCI, 1 ISA
Integrated Adaptec PCI Ultra-Wide SCSI-3 controller
Integrated Intel EtherExpress™ Pro 100 controller
12/20X SCSI-2 CD-ROM drive
10 drive bays: 4 external 5.25"/1 external 3.5"
2 internal 5.25"/3 internal 3.5"
Microsoft Windows NT Server 4.0 (10-user license)
Intel LANDesk Server Manager 2.8
Dedicated server technical support, 7x24
5-year/3-year Micron Power limited warranty
1-year next-business-day on-site service*

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9 expansion slots: 6 PCI, 2 ISA, 1 shared ISA/PCI
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Integrated Symbios Narrow SCSI-3 controllers
Intel EtherExpress Pro 100 NIC
Embedded RAID upgrade option
120 Compliant via embedded Intel i960-RD
5 Internal, hot-pluggable, hard drive bays
(Upgradable to 10)
3 External 5.25" media bays
1 (one) 360 watt hot-pluggable power supply standard
(Upgradable to 3 for added redundancy)
Rack Adapter option
Intel LANDesk Server Manager 2.8
Microsoft Windows NT Server 4.0 (10-user license)
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1-year next-business-day on-site service*

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30-day money back policy
24-hour technical support
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TransPort XKE

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S3 VIRGE graphics accelerator, 2MB EDO RAM
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Chassis Intrusion Alert
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Microsoft Windows® 95
Intel LANDesk® Client Manager
5-year/3-year Micron Power™ limited warranty

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16X modular CD-ROM drive
Li-Ion battery
12.1" TFT SVGA, 800x600 display

STANDARD FEATURES

Intel 430MX PCI chip set
256KB L2 pipeline burst cache
PCI bus with 128-bit graphics accelerator
MPEG compatible
Zoomed Video-ready
Touchpad pointing device
16-bit stereo sound
Built-in stereo speakers and microphone
2-way infrared port
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17" Micron 700FGx, .26dp (16.0" display)

STANDARD FEATURES

512KB internal L2 secondary cache, DMI support
16X EIDE variable speed CD-ROM drive
3.5" floppy drive
3Com PCI 10/100 ethernet NIC
PCI 64-bit 3D video, MPEG, 4MB EDO RAM
Upgradable wavetable audio with speakers
Tool-free minitower or desktop
Microsoft IntelliMouse, 104-key keyboard
Microsoft Windows NT® Workstation
Intel LANDesk Client Manager
5-year/3-year Micron Power limited warranty

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MICRON TRANSPORT XKE

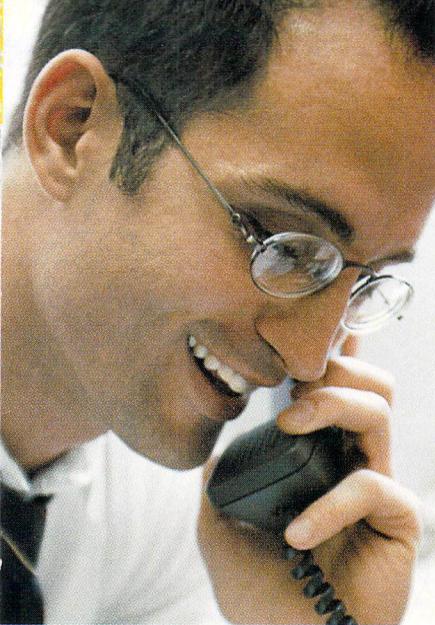
233MHz Intel Pentium processor with MMX technology
48MB EDO RAM (192MB max.)
3GB removable hard drive
13.3" TFT XGA display

STANDARD FEATURES

Intel 430TX Mobile PCI chip set
512KB L2 pipeline burst cache
PCI bus with 128-bit graphics accelerator, 2MB DRAM
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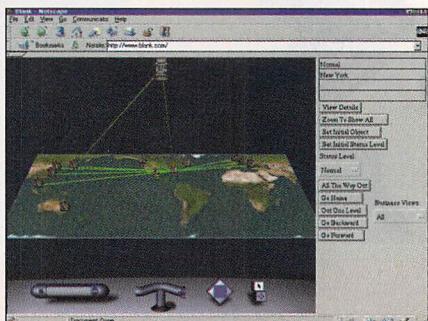
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	# Of Developers	Develop Time (mos.)	Person Mos.	With TNG Framework
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Object Repository	8	12	96	Available Now
Auto Discovery	6	9	54	Available Now
Calendar Management	5	8	40	Available Now
Virus Detection	3	7	21	Available Now
Reporting	4	5	20	Available Now
Business Process Views	6	7	42	Available Now
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Why waste time? Unicenter TNG Framework can save you countless months.

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BEYOND PENTIUM III

By Tom R. Halfhill **80**

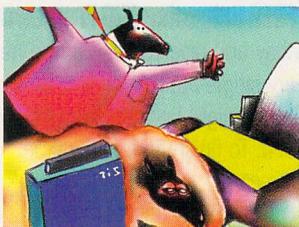
The first detailed look at the new breakthrough microprocessor architecture from Intel and Hewlett-Packard—and what it will mean for developers and users.



Beyond MMX

By Tom R. Halfhill **87**

New 3-D power of AMD, Centaur, and Cyrix chips will challenge Intel.



BUILDING NETWORK APPS

COM+: The Next Generation **99**

By David Chappell
Microsoft's next Component Object Model will make it easier to create and use objects.

MANAGING DATA

Commanding the Enterprise **93**

By Karen Watterson
Soon you'll be able to manage the network and all those devices from one console.



SPECIAL REPORT EXTENDING THE ENTERPRISE

The Extranet Revolution

65

Defending from the Unthinkable

67

Extranets at Your Service

75

INTERNATIONAL

Your Only Inbox

44IS 9

By Bob Emmerson

Next-Generation Notebooks

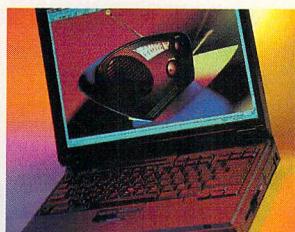
44IS 13

By Stella Kao

1997 Editors' Choice Awards

103

We honor software and hardware that prove innovation was alive and well in 1997.



EDITORIAL

Step Aside, x86

14

INBOX

17

BITS

Centaur's New WinChip

24

Ultraportables Get

More Power

25

Chips Promise Cheaper

Modems

28

Future Watch: I20

Processors

28

DVD: A Moving Target

30

A Voice for Java

Developers

44

EVAL

OPERATING SYSTEM

Microsoft Laces Up

for the Enterprise Race

45

By Morgan Stern and Gary Monti
Enterprise-ready Windows
NT 4.0.

INTERNET PHONES

Smart Phones Make

the Grade

47

By Michelle Campanale
Mitsubishi's MobileAccess and
Samsung's Duette.

LAB REPORT

SOFTWARE

Toolkits for Building

Web Applications

118

By Steve Gillmor

We look at seven site-building and maintenance kits to help you choose the right one.

HARDWARE

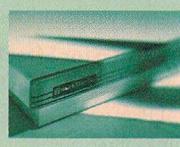
Back to the Future with 9 Network

Computers

124

By Michelle Campanale

We test the current crop of thin clients to see what they're good for.



WEB PROJECT

The Value of Free Software

109

By Jon Udell

Freeware gems like Apache, Linux, and Perl keep the Web spinning.

REVIEWS

DATA ACCESS TOOLS

Drive Your Data Through

the Middle(ware)

132

By Barry Nance

We test two middleware programs that take the muddle out of multiple databases.

GRAPHICS SOFTWARE

3-D Animation Blossoms on NT

133

By David Em and Alex Pournelle
Three high-end programs let you create Hollywood-quality 3-D animation on an NT workstation.

JAVATALK

Poet Goes Java

113

By Rick Grehan

An OODBMS takes the plunge into Java.

CHAOS MANOR

Fire Three for Effect!

139

By Jerry Pournelle

Building a new dual Pentium Pro system is a snap, until you try to put it on the network.

OPERATING SYSTEM

The Be-All-That-You-Can-Be OS

137

By Peter Wayner

A new OS offers users a new set of options.

CORE

DATABASES

Managing Data

Transformations

53

By Colin White

Data requires careful control and cleansing to make it useful for business decisions.

OPERATING SYSTEMS

Speech Enables the Common

Desktop PC

55

By Joseph J. Lazzaro

Powerful processors, cheap memory, and a hardware standard enable speech recognition

and synthesis on out-of-the-box PCs.

NETWORKING

Demystifying ATM Addressing

57

By Jeffrey N. Fritz

Before connecting your ATM network to the outside world, consider its addressing scheme.

CPUs

Making Personal Video

a Reality

59

By Les Kohn and Greg Efland
A video compressor/decom-

pressor from C-Cube enables real-time MPEG-2 encoding for PCs.

PROGRAMMING

Dynamic HTML Explained,

Part II

61

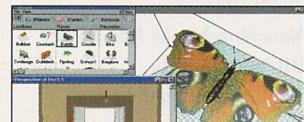
By Rick Dobson

This month's installment explains how programmers can create interactive objects for their Web pages using DHTML.

WHAT'S NEW

163

MetaCreations' Ray Dream 3-D, Tektronix's new color printer, better OCR from ScanSoft, and more hardware and software.



IMPROBABLE

Cell Death

168

A great new way to terminate annoying cell-phone calls.

SERVICE

Reader Service

Inquiry Reply Cards 160A-B

Index to Advertisers

Alphabetical Order 160

Editorial Index

by Company 162

THE BYTE WEB SITE and THE VIRTUAL PRESS ROOM

<http://www.byte.com>

PROGRAM LISTINGS

FTP: <ftp://ftp.byte.com>

From BIX: Join "listings/frombyte97" and select the appropriate subarea (i.e., "dec97").

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CONTENTS BY PLATFORM

WINDOWS

A PC Chip for the Masses

Centaur's new WinChip C6 processor provides good performance for sub-\$1000 Windows PCs.

New Notebooks Add Power, Ultraportability

Thanks to intriguing new designs for ultrathin notebooks, the price of Win 95 portability is becoming less precipitous.

SQL Server Suite Spot

Our reader survey shows which Microsoft BackOffice products are the most popular.

Microsoft Laces Up for the Enterprise Race

We evaluate Microsoft's enterprise-ready Windows NT 4.0.

Speech Enables the Common Desktop PC

Today's x86 machines can handle speech processing without custom hardware. Microsoft's Speech API will allow you to mix and match speech recognition and text-to-speech products.

Making Personal Video a Reality

A one-chip MPEG-2 codec makes DVD authoring possible on a PC.

Beyond Pentium II

A look inside the 64-bit architecture that Intel and HP are building as a foundation for tomorrow's computers.

Beyond MMX

AMD, Cyrix, and Centaur are cranking up the x86's 3-D graphics performance with extensions to the architecture.

COM+: The Next Generation

Microsoft's upcoming COM+ will make multilanguage development easier, especially for C++ programmers.

1997 Editors' Choice Awards

Windows products rack up a passel of BYTE awards.

3-D Animation Blossoms on NT

Powerful packages ported to NT enable professional 3-D animation on (relatively) inexpensive workstations.

Fire Three for Effect!

Jerry finds that Win 95's Plug and Play is not as smart as it thinks it is.

JAVA

A Voice for Java Developers

Rick Ross, founder of the Java Lobby, sounds the alarm on the effects of a fractured Java platform.

1997 Editors' Choice Awards

Borland's JBuilder, Symantec's Visual Cafe, Sun's Java Workshop, and Iona's OrbixWeb are among the best of the year.

Poet Goes Java

An object-oriented database now comes with a Java development kit.

NETWORKS

ADSL Vendors Work for Interoperability

Agreements will help pave the way for interoperable products that deliver faster Internet access.

Microsoft Laces Up for the Enterprise Race

A new, heavyweight version of Windows NT Server should satisfy enterprise needs until 5.0 arrives.

Smart Phones Make the Grade

New devices incorporate voice and data for e-mail, Internet access, and just plain talking.

Demystifying ATM Addressing

While network administrators wouldn't think of creating arbitrary IP addresses, some do so without hesitation for ATM addresses. Here's why this isn't a good idea.

Dynamic HTML Explained, Part II

Techniques for dynamic positioning, dynamic content, and multimedia effects.

Beyond Pentium II

The new 64-bit microprocessor architecture being developed by Intel and HP will first appear in high-end servers.

Commanding the Enterprise

Single solutions to enterprise management are closer than ever.

1997 Editors' Choice Awards

Tools of the Net trade dominate this year's winners.

The Extranet Revolution

Extranets are revolutionizing how businesses communicate.

Defending from the Unthinkable

Firewalls alone can't turn an intranet into an extranet, but a multifaceted security strategy will work.

Extranets at Your Service

Need an extranet? From complete outsourcing to turnkey systems to do-it-yourself tools, your choices are growing.

The Value of Free Software

A look at the freeware that powers much of the Net.

Toolkits for Building Web Applications

We review seven tools for building and maintaining Web sites and applications.

Back to the Future with Nine Network Computers

Our tests will help you decide if these devices are more than just a blast from the past.

Drive Your Data Through the Middle(ware)

What's the best way to connect a variety of clients to a variety of databases on a variety of servers? The answer's on this page.

INDEX

ADSL 38
Animation 133
Apache 109
ATM 57
BeOS 137
Chips 24, 28, 59, 80, 87
Clients, thin 124
COM+ 99
Components 99
Database technology 53, 113, 132
Data transformation 53
DVD 30
Enterprise management 45, 93
Extranets 65, 67, 75
Freeware 109
Graphics, 3-D 87, 133
Groupware 53
HTML, Dynamic 61
IA-64 80
Installation hassles 139
Internet/Web 25, 47, 61, 75, 93, 103, 109, 118
Intranets 65
IPsec 65, 67
I2O 28
Java 44, 99, 113
Linux 103, 109
Metadata 99
Microprocessor architecture 80, 87
Middleware 132
MMX 24, 25, 80, 87
Mobile computing 25, 47
MPEG-2 59
Network computers 124
Networking 28, 38, 45, 47, 57, 65, 67, 75, 93, 109, 124, 132, 139
Objects 61, 93, 99, 113
Operating systems 45, 55, 99, 109, 137, 139
Perl 109
Phones, smart 47
Plug and Play 139
Programming 44, 61, 67, 75, 80, 87, 99, 103, 109, 113, 118
Security 67, 93
Speech technology 55, 103
Video 59
x86 14, 24, 80, 87

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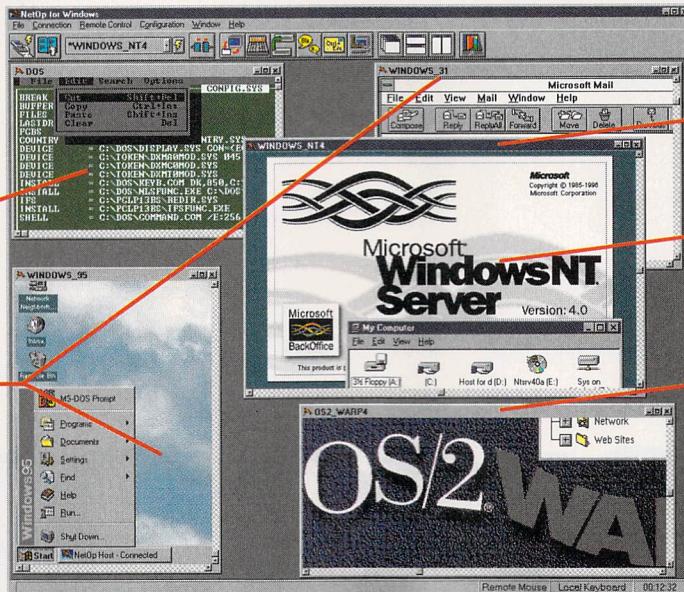
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editorial

Step Aside, x86

Merced is the beginning of the end for the world's most popular PC chip. What will a new architecture bring us?

In this issue we take the first hard look at the future of computing as defined by Intel. What will post-Pentium computing be like?

We already know something about that, because 64-bit architectures have been available on RISC/Unix systems for several years. Arguably, they've enabled a whole new art form. Works from *Toy Story* to *Babylon 5* show what graphic artists can do with practical, high-res, 3-D animation on platforms such as Silicon Graphics' workstations.

On a less obvious note, analysts both scientific and financial have benefited from the throughput and large memory capabilities of the 64-bit workstation.

But what about the average user? Are we all now going to navigate through 3-D models just to answer our e-mail? I hope not. My real desk is messy enough; I don't need to sift through virtual clutter as well.

Multimedia would seem to be an obvious benefit of the new architecture: It was the original killer app for high-end 32-bit computing. But we're at a crossroads. Today's computers are basically good enough for local video. Tomorrow's will be dependent on sufficient bandwidth for network video, and that will arrive well after the 64-bit business desktop.

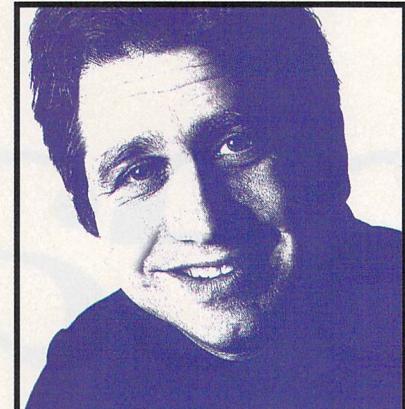
One of the best uses of this power would be to cross the last mile to true real-time speech-to-text synthesis. The best products ever are on the market right now, and they're just short of acceptable for continuous, speaker-independent use.

Large memory applications—an unsexy but useful concept—are another great use for the new architecture. Think of it as an obese client; you run an entire multidimensional database in RAM on your own desktop. Answers to very complex questions appear in seconds.

The new chips will have a huge impact on servers. I just spent three days at a data-warehousing summit conducted by Dr. Richard Hackathorn for Lockheed Martin (Hackathorn often writes about databases for BYTE). I heard from organizations as diverse as Citicorp, NASA, and US West, which are already running multiterabyte data warehouses. The large memory addressing of 64-bit computers, coupled with their higher throughput, will help many businesses approach those multiterabyte levels with inexpensive symmetric multiprocessing servers.

The same phenomenon applies to Web servers. Do CGI scripts, Java servlets, and database access overwhelm your Web server? Next-generation chips should be a quantum leap in price/performance.

Finally, let me make a plea for a new way to use all this power. The average



ers were still a hobbyist item. Since then, PCs have carried a lot of baggage and entailed a lot of compromises. Let's hope that Intel uses the clean slate of a new architecture to the best advantage.

New technology means new risks,

Let's take 25 percent of all the new cycles and use them for intelligent self-management.

business desktop has all it needs to run typical productivity apps. Let's take 25 percent of all the new cycles over today's 32-bit, 300-MHz Pentium II desktop and use them for intelligent self-management. I recently learned from Lucent that a typical large corporate PBX has 5 million lines of code and that 55 percent of it is self-administering. According to Lucent, 80 percent of software problems are resolved by the system itself. OK, a PC is more versatile than a PBX, but I'd like to see that design philosophy take hold in the near-supercomputers you'll have on your desk in the 64-bit era.

Perhaps the greatest significance of the new IA-64 architecture lies in the opportunity to do some urban renewal on the kludgy landscape of the x86. The x86 architecture started when microcomput-

though, and never before in the history of the PC has the risk been larger. Intel, along with Microsoft and many application vendors, will have to provide as much backward compatibility as possible. The new Intel architecture is probably a bigger departure from the past than Apple's switch from the 68000 to the PowerPC. After all, the PowerPC used RISC technology—a known quantity—while Intel will use a totally new architecture. We'll certainly keep you informed as the details become clearer.

Mark Schlack

Mark Schlack, Editor in Chief
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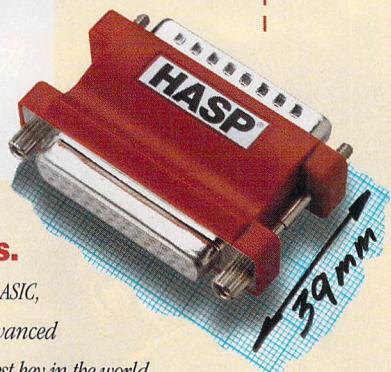
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Inbox

My Wish List

In "Windows Wish List" (October Bits), Jim Allchin indicated that Microsoft was working to complete NT 5.0. It is my understanding that a reasonable definition of a beta release is a version of the software that is put out for testing and user feedback. The company then fixes problems and publishes bug fixes. By this definition, NT 4.0, which is now up to Service Pack (aka bug fix) 3 with a goodly handful of "hot fixes" to fix the bugs in the bug fixes, is still in beta release (i.e., not finished). Perhaps Microsoft should concentrate on completing software that is "out there" before starting to complete the next version's beta release.

John McMinn
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Java Vu

"Building a Better Interface with Java" (August Core) left me with a strong feeling of déjà vu. The new Internet Foundation Classes (IFC) sounded promising but also familiar. Quickly browsing the source code I downloaded from Netscape's Web page confirmed my suspicions. The IFC is nothing new at all. In fact, it's been around for almost 10 years. It has gone through three major revisions and two OS migrations. It's been deployed in mission-critical applications in many large corporations for years. It's called OpenStep (formerly

NextStep). Everything described in the article is analogous to technology present in the AppKit, FoundationKit, and Interface Builder. Even the method names and instance variable names that I gleaned from the source were the same as their OpenStep counterparts. But there was no reference to OpenStep in the article, except an offhand remark about Apple's Interface Builder.

If this represents the Java "future," we could have had it back in the 1980s. If the Java revolution had been a bytecode compiler for Objective C, I'd have something to write home about.

*Craig Halley
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You're right. IFC is a very close cousin to the Next AppKit. Perhaps one of the reasons for this (aside from the fact that the AppKit was/is such a wonderful piece of software and a good one to copy) is that the IFC was written by former Next engineers led by Jayson Adams. If you're curious, take a look at the FAQ and newsgroup that Netscape has set up for IFC. You can find them at <http://developer.netscape.com/library/ifc>.—Andy Turk

A Working PC: Not the Holy Grail

I know you have read letters like this before, but perhaps you will be more in tune



with the concepts after your editorial ("The Net PC Blues") in the September BYTE. I run a Web server 24 hours a day, 7 days a week. It is a 133-MHz 486 VL-Bus system with two Enhanced IDE (EIDE) drives and 32 MB of RAM. It has three modems attached, two connected full-time to the Internet and one for incoming calls and outbound faxing. It has a VL-Bus graphics accelerator, two standard 16550 serial ports, a smart eight-port serial card, trackball, voice synthesizer, 400-MB quarter-inch cartridge (QIC) 80 tape drive, 3½- and 5¼-inch floppy drives, and a color hand scanner. Three printers are attached to the system.

There are also three dumb terminals and an Ethernet card leading to another PC. There are hundreds of megabytes of software installed on the system, some DOS, some Windows, some "other." Third-party device drivers abound.

This system has been up and running for three years. I never reboot to change OSes, clear hung programs, or anything else.

To blame your PC design or hardware for your crippled computing environment only illustrates how brainwashed you are. It is not important what my OS is, it is simply a matter of what it is not—Windows 95.

David Butcher
davidbu@chezhal.slip.netcom.com

Rich Content vs. News Client

I object to the statement "Discussion data no longer needs to propagate around the world by way of replication. [...] News clients can hop instantly from server to server, just as Web clients can." in "HTML + NNTP =

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Groupware" (September Web Project).

I'm a regular newsgroup user at Supelec and enjoy LAN speed when reading the news (almost instantaneous, even when there are pictures). Sometimes I read the news from Georgia Tech Lorraine, a French Georgia Tech campus that doesn't have a news server. We default to the fastest one available—Supelec. This cuts down our download bandwidth from 300 Kbps to about 5 Kbps and makes it a nightmare to read any "enhanced message" such as the HTML files with pictures, etc., you seem to be advocating. One of the advantages of the Usenet compared to the Web is its speed, which is due to both simple ASCII content and local replication. Your suggestion of a Usenet without data replication and with rich content would kill this advantage.

*Benoit Cerrina
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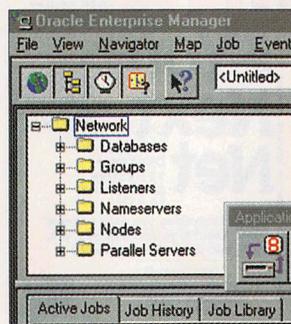
Replication certainly has its uses. However, I would draw a sharp distinction between "rich content" and "HTML files with pictures." A lot of the enrichment that comes from the use of HTML in an NNTP context is simply the enrichment of text with styles, colors, tables, and hyperlinks. None of this need involve bulky pictures; it's just ASCII text that happens to include HTML markup. Used this way, I find NNTP—even at typical over-the-Internet Web-page-transfer speed—to be an enormous enhancement over plain ASCII.—Jon Udell

Not Worth the Wait

I read with interest "Oracle8: Worth the Wait?" (Septem-

ber review) and felt that once again, a professional in the database arena has put forward a very pro-Oracle article without comparison to other databases.

I find it surprising that Informix does not get the credit it deserves when you look at the products that are



available for all platforms, including NT 4.0. Oracle is very clever when it comes to marketing jargon. What is considered to be new technology, in fact, it announced in 1992. Look at the Informix product range. You'll find that the features that everyone is so excited about in Oracle8 are old hat when it comes to the on-line DSA engine—table fragmentation, parallel data queries (PDQs), virtual processors, hot archiving, and so forth.

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I don't think the review was too positive, given the criticisms of the complete lack of object-oriented technology, the poor programming interface, and the consequent downrating of the product. I'm not really an expert on Informix, SQL Server, or Sybase, but the real problem with these products (Sybase aside) is that, unlike Oracle, they don't run on many OSes. You can also criticize Informix for its thick-client

datablade approach, the heavy-handed way it does database extensions, and a lack of relatively strong object-oriented features in all these systems. I would also criticize all these vendors for their inability to conform to a reasonable level of the SQL2 standard, much less to the upcoming SQL3 standard.

—Robert J. Muller

the real problem: addressing new business needs. Only a high-level tool can move information technology (IT) forward and deal intelligently with such issues as the Y2K bug, Euro currency, mobile users, and market globalization.

*Alain Stouder
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FutureComm

I enjoyed "Air War" (August Special Report), on the current status of cellular phone availability. I just returned from an around-the-world business trip and had my first exposure to Global System for Mobile Communications (GSM). I wasn't aware that this worldwide capability existed. I find the information given out by local U.S. phone/PCS (Personal Communications Services) providers very limited. One system that I've heard is coming in 1998 is Iridium. Won't it be a global system when all the satellites are up?

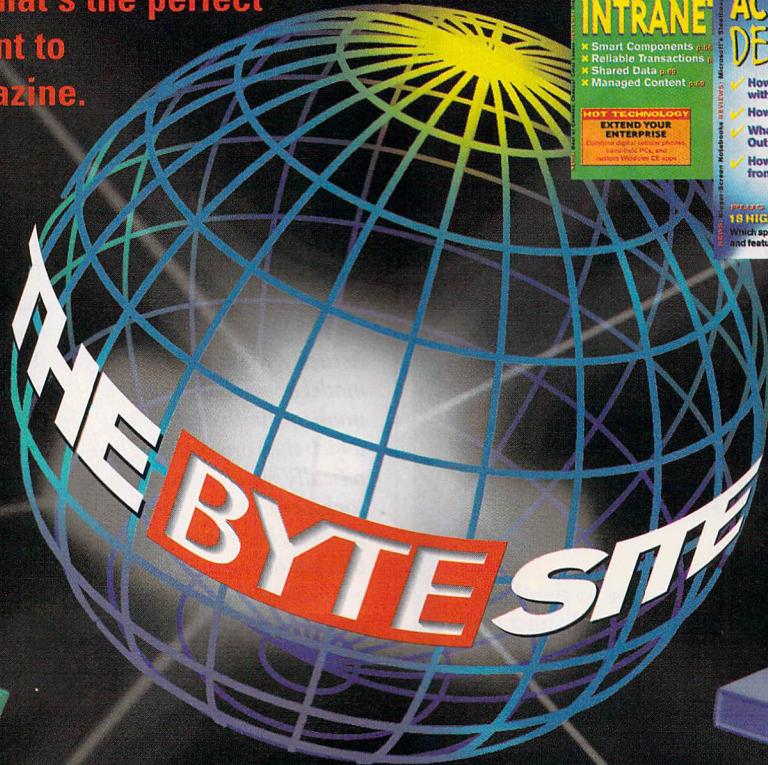
*E.J. Parks
ejpvip@home.com*

Motorola's Iridium system is intended to provide global coverage through a network of low-earth-orbit (LEO) satellites. Interested readers should see "Fiber in the Sky" (November Cover Story); we treated LEO (including Iridium) and other satellite technologies in that story.—Eds.

Net Dream, Net Reality

Three years ago, I got a fancy for OS/2. This year, I purchased Warp Connect. Everything seemed OK. I downloaded Java Development Kit (JDK) 1.0.2 for OS/2, Netscape 2.02 for OS/2, and some lecture notes on

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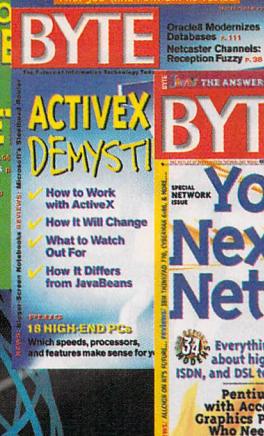
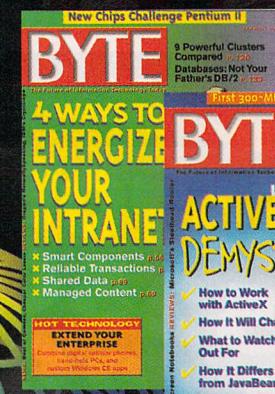
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Java. You can imagine my frustration when I realized that I couldn't run a network applet connecting to a host, even if the host had granted access, because Netscape wouldn't let me do so for security reasons. I believe security should be the host's problem, as in Unix, not the browser's problem. Are Java applets for thumbtling ducks and Push Me buttons only?

*Augustin Man
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Actually, the current security model does let applets communicate with the host on which they originated. Theoretically, you can use a socket connection for this purpose, but some firewalls block those connections. I got around this problem in one of my applets by URL-

encoding the data and sending it back on the HTTP connection. A Perl script running on the host receives the data. Programming books on Java and HTML explain this in more detail and usually include some sample code.

—Tom Halfhill, senior editor

Fixes

The Features table in "Power Platforms: 233- and 266-MHz Pentium IIs Compared" (September Lab Report, p. 102) contained some inaccuracies regarding the Millennium graphics cards in several of the systems. The Millennium cards use WRAM and are 64-bit. The Millennium II does not support more than 16 MB of memory.

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Microsoft wants to push Windows CE 2.0 beyond the hand-held device to power mini-notebooks and a new generation of embedded devices. We take it for a spin.

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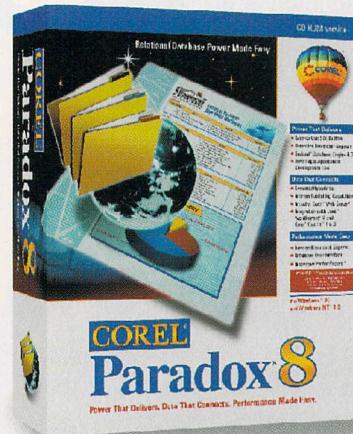
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A PC Chip for the Masses

Centaur's new WinChip C6 delivers application performance that approaches that of a 200-MHz Pentium with MMX at an appealing price.

Centaur's WinChip C6 processor isn't the fastest x86 processor we've tested, but its performance approaches that of a 200-MHz Pentium with multimedia extensions (MMX), and at an attractive price. Centaur, a subsidiary of static RAM (SRAM) and RISC processor manufacturer Integrated Device Technology, has created a CPU that's small (just 88 square millimeters compared to 141 square mm for the Pentium MMX) and streamlined (for more information, see "Keeping It Simple," October BYTE).

Although benchmark tests indicate that the performance of a 200-MHz WinChip C6 is below that of a 200-MHz MMX Pentium, the chip is priced attractively at \$135 for the 200-MHz version, compared to the \$252 (in quantities of 1000) that a 200-MHz Pentium with MMX technology cost at press time. The WinChip C6 targets PCs costing \$1000 or less. The 180-MHz WinChip C6 costs just \$90. Centaur plans to release 225- and 240-MHz versions of the CPU in this quarter.

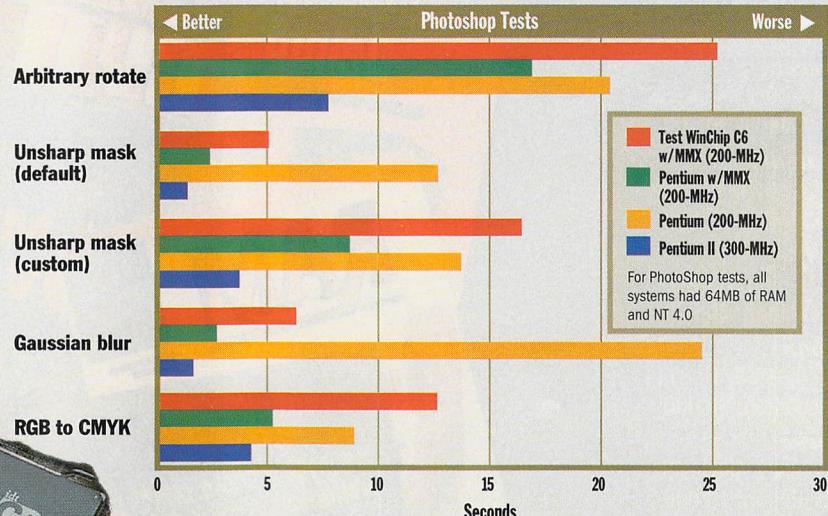
BYTE tested a 200-MHz WinChip-based PC using the BYTEMARK CPU/FPU and Photoshop application benchmarks. As Centaur engineers predicted, the chip didn't perform very well compared to a 200-MHz Pentium processor in the BYTEMARK CPU/FPU tests, which are CPU-intensive, synthetic tests. According to Centaur officials, the WinChip C6 would do better in Windows application tests than in BYTEMARKS compared to a Pentium. Our Photoshop tests confirm Centaur's assertions.

BYTE tested the 200-MHz Pentium and WinChip C6 CPUs in the same reference system running Windows NT 4.0. As we do when running Photoshop tests on other



Centaur's WinChip C6 delivers decent performance at an attractive price.

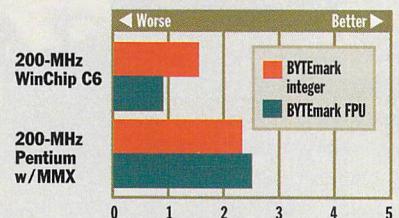
WinChip C6 vs. Pentium



systems, we configured the system with 64 MB of RAM to minimize hard drive activity and measured performance only in terms of the processing time required to complete each operation to deemphasize video card performance. We ran the tests at 1024- by 768-pixel resolution and 256 colors on the Pentium/WinChip C6 system, because that was the maximum color depth the system supported at that resolution. We also include the scores of an AST 300-MHz Pentium II-based system tested at the same color depth and pixel resolution.

In Photoshop operations that make use of MMX, such as the default unsharp mask and Gaussian blur (but not the RGB to CMYK mode change), the WinChip C6 beat a non-MMX Pentium 200. And in two operations that are not MMX-intensive—arbitrary rotate and the custom unsharp mask—the non-MMX Pentium

Centaur: Decent Integer, Poor FPU



200 edged the WinChip C6. (Intel says the performance benefit accrued from MMX optimization in the unsharp mask test starts diminishing when the radius setting is at 4 or more pixels, and in the custom unsharp mask operation, our setting is 10 pixels. For more information on the Photoshop tests, see page 27 of the February BYTE or <http://www.whidbey.com/gallery/photoshop>.)

All this suggests that Centaur's support for MMX will make the WinChip C6 a better processor for some MMX-optimized operations than a plain Pentium.

But Intel is rapidly phasing out non-MMX chips, and in MMX-optimized operations, the Pentium with MMX beats the WinChip C6.

Centaur officials say they will improve the WinChip C6's MMX performance as well as its rather dismal floating-point performance in the future. Adobe officials say the Photoshop tests that BYTE runs are predominantly integer-based. The arbitrary rotate test does use floating-point slightly during the setup, but this doesn't account for a significant amount of time. Nevertheless, the WinChip C6's poor BYTEMARK FPU score indicates that it is not a great chip for running FPU-intensive applications such as CAD.

With speed increases and other enhancements, the WinChip C6's performance will continue to improve. Even at its current performance, it's worth checking out if you're in the market for an inexpensive PC. Power users who need maximum performance will need to look elsewhere.

—Dave Andrews

Geek Mystique

Internet Influence Increases

More tidbits of information compiled by Win Treese (treese@OpenMarket.com) about the ever-growing influence of the Internet in our daily lives. Past issues and citations to sources are found at <http://www.openmarket.com/intindex/>.

100—Number of delinquent taxpayers listed on the Web page of the Connecticut Department of Revenue Services.

30—Estimated percentage decrease in the number of delinquent taxpayers since the Web site went on-line.

4133—According to Boardwatch magazine, approximate number of Internet service providers (ISPs) in the U.S. and Canada in August.

1447—Number of ISPs listed by Boardwatch in February 1996.

561.5—Amount of venture-capital investments in Internet companies during the second quarter of this year, in millions of dollars.

111—Number of companies receiving the money.

20—Number of Americans who consider the Internet "indispensable," in millions.

1—Rank of censorship by

users concerned about issues facing the Internet.

1—Rank of Internet security among accountants' top technology concerns.

41—By the year 2000, estimated percentage of Internet commerce related to travel.

2.7—Estimated number of e-mail messages sent this year, in trillions.

6.9—Estimated number of e-mail messages to be sent in the year 2000, in trillions.

New Notebooks Add Power, Ultraportability

Thanks to new mini-notebooks and ultrathin notebooks, the performance penalty is becoming less precipitous for users who place a big emphasis on portability.

Most users are familiar with the trade-offs involved in ultraportables for Windows 95, especially with the mini-notebook (aka subnotebook) class of systems such as Toshiba's Libretto. The small size and light weight of mini-notebooks, combined with the ability to run Windows 95 applications, appeal to a particular class of user who values portability and remote connectivity, and needs to compute in tight spaces.

However, due to smallish screens and keyboards and other compromises, mini-

notebooks have received a lukewarm reception in the U.S. Toshiba sells the Libretto in the U.S. and Japan, but several other companies market their mini-notebooks in Japan only, including IBM, with its ThinkPad 535E, and Panasonic, with its Lets Note Mini. "Hand-held systems like the 535E are more popular in Japan, where space is at a premium," says a spokeswoman for IBM. "Users there don't seem to mind the smaller keyboards as much."

Toshiba officials say Libretto users in the U.S. are typically knowledgeable about notebooks and use the mini-notebook as a remote computing device that complements their primary system.

Toshiba recently improved the Libretto's performance and storage by adding a faster processor (the new Libretto 70 features Intel's 120-MHz Pentium with multimedia extensions [MMX]) and a bigger hard drive (1.6 GB). But newer mini-notebooks that are slightly larger than the Libretto may expand the mini-notebook user base in the U.S. For example, Mitsubishi's Amity CN and Hitachi PC's Mini-Note have 7.5- and 8.4-inch displays, respectively (compared to the Libretto's 6.1-inch LCD), and both are about an inch wider.

One size up from these new mini-note-

books is an intriguing new portable, the ultrathin Pedion, from Mitsubishi. Due to its thin LCD screen and keyboard, magnesium body, and other components, the base Pedion weighs just 3.3 pounds and is only 0.7 inch thick. Yet it has a 12.1-inch screen, a 1-GB hard drive, and a 233-MHz Pentium with MMX. The Pedion's base unit doesn't include a CD-ROM drive. A modular docking station, called the multimedia slice, weighs 2 pounds and houses

Contents

Coming: More I20 Processor Choices

28

New Chips for Smaller, Cheaper Modems

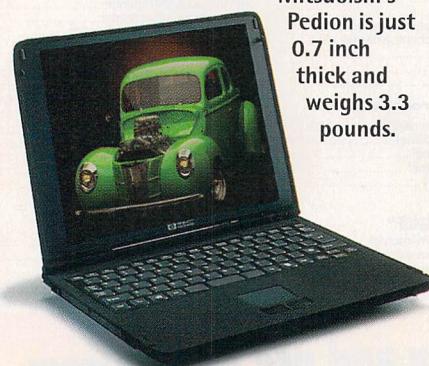
28

CD-x vs. DVD: Which Drive Is for You?

30

Programmer's Perspective on the State of Java

44



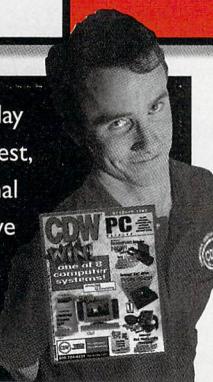
Mitsubishi's Pedion is just 0.7 inch thick and weighs 3.3 pounds.



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UMAX Astra 1200S scanner	.168.64
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Visioneer PaperPort Strobe scanner	.249.99

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MAG Innovation 510V2 15" 0.28mm	.298.44
MAG Innovation 510V2 17" 0.28mm	.495.26
Magnavox MV5011 15" 0.28mm	.220.16
Magnavox MB7000 17" 0.28mm	.479.98
NEC MultiSync E500 15" 0.25mm	.374.91
NEC MultiSync E700 17" 0.25mm	.659.18
NEC MultiSync E1100 21" 0.28mm	.1249.22
NEC P750 17" 0.25mm	.785.91
NEC P1150 21" 0.28mm	.1388.76
Princeton E500 15" 0.28mm	.267.44
Princeton E700 17" 0.28mm	.469.36
Princeton E900 19" 0.26mm	.849.20
Samsung SyncMaster 500s 15" 0.28mm	.279.00
Samsung SyncMaster 700s 17" 0.28mm	.549.00
Sony Multisync 100s 15" PnP 0.25mm	.327.21
Sony Multisync 200s 17" PnP 0.25mm	.604.03
Sony Multisync 300s 20" PnP 0.30mm	.1385.92
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ViewSonic E655 15" 0.28mm	.279.02
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3Com 33.6K 10BT LAN+modem combo	.299.12
3Com 32-bit Fast EtherLink CardBus	.147.57
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Hayes ACCURA 56K	.189.76
Intel EtherLink PRO/100	.148.89
32-bit Card Bus adapter	.158.10
Motorola Mariner 33.6K	.359.16
Motorola MobileSURF 56K	.167.22
New Media PC Card joystick adapter	.59.75
Practical Peripherals 33.6K	.149.46
Practical Peripherals 56K Flex cellular	.179.91
Simple 33.6K Communicator w/SimpleJack	.139.09
Simple 56K Communicator	.154.72
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MINI-NOTEBOOKS							
Toshiba Libretto 70 800-334-3445 http://www.computers.toshiba.com	1.9	8.3x4.5x1.4	120-MHz Pentium with MMX; no secondary cache	6.1 inches	1.6 GB/32 MB	External floppy drive, CD-ROM drive, one Type II PC Card slot	\$1999
Hitachi PC Mini-Note 800-448-2244 http://www.hitachipc.com	2.7	9.2x6.8x1.3	133-MHz Pentium with MMX; no secondary cache	8.4 inches	1GB/40 MB	External floppy drive, external CD-ROM drive, three Type II or one Type II and one Type III PC Card slots	Between \$2500 and \$3000
THIN NOTEBOOK							
IBM ThinkPad 560X 800-426-7255 ext. 4751 http://www.us.pc.ibm.com/thinkpad	4.1	11.7x8.7x1.2	233-MHz Pentium with MMX; 256-KB L2 cache	12.1 inches	4 GB/96 MB	External floppy drive, CD-ROM drive, two Type II or one Type III PC Card slots	\$1999
ULTRATHIN NOTEBOOK							
Mitsubishi Pedion +81 3 3218 2111 http://www.mitsubishi.com	3.3	11.9x8.7x0.7	233-MHz Pentium with MMX; 256-KB L2 cache	12.1 inches	1 GB/64 MB	Floppy drive and CD-ROM drive in dock, two Type II or one Type III slots	About \$4900 ¹

¹Available only in Japan at press time.

Future Watch

New I2O Processors



New processor options are coming for I2O subsystems to compete with the i960 from Intel. At least one vendor, Digital Equipment, will offer an Intel alternative in 1998, and others may be on the way, too.

The port of Wind River Systems (Alameda, CA) IxWorks, the I2O real-time OS (RTOS), should be completed in the first half of 1998 for Digital's StrongArm chip. Additionally, Digital's new 21553 and 21554 PCI-to-PCI bridge chips are slated to appear early next year, providing support for 64-bit PCI cards.

The bridge chips also support independent primary and secondary address spaces, which means they don't take away from the main CPU's memory allocation in cases of I2O implementations that use a peripheral cache.

A spokeswoman for Wind River says the company is also working with vendors besides Digital and Intel on porting its RTOS to other processors, and Intel officials say you can expect new i960s in 1998 that offer improved scalability and throughput, but they would not comment further.

a floppy drive, a 20x CD-ROM drive, I/O ports, and an additional universal serial bus (USB) port. Another slice adds an additional lithium-polymer battery to increase estimated battery life from 2 to 8 hours. At press time, the unit was available only in Japan at a starting price of about \$4900, but thanks to an agreement between Mitsubishi and Hewlett-Packard, HP will sell a Pedion-like system in the U.S. early next year.

Mitsubishi officials say the Pedion was

designed with the U.S. market in mind: The screen is much bigger than that of a mini-notebook, and the larger keyboard is designed for touch-typists. "Whether this represents a new category or not is hard to say," says Robert Langerman, marketing manager for HP OmniBooks. "At the least, it is a radical evolution of the ultraportable category, targeting high-level executives who are sensitive about their notebook's size and weight."

—Dave Andrews and Trevor Marshall

Cheaper Modems for ISPs

New chips for Internet-access modems will deliver more communications capabilities in a smaller and cheaper package. The technology that makes life easier for Internet service providers (ISPs) and central-office access providers will soon be available to vendors who make modems for end users.

Analog Devices' (Norwood, MA) ADSP-21mod870 is one such chip, and it has several advancements that should interest remote-access server equipment manufacturers. Unlike other solutions that require multiple chips to perform all of a modem's functions, Analog's chip (the picture on page 30 shows the actual size) squeezes a controller, data

pump, and I/O onto one chip, plus 160 KB of on-chip static RAM (SRAM), for a low price of just \$28. The chip's digital signal processor (DSP) technology lets it handle numerous modem protocols, including V.34, 56-Kbps flex, fax, and ISDN. The small size of the chip means the same space in a modem rack that used to hold 12 modem ports (connections) will be able to hold 24 to 48 modem ports, Analog officials say.

"With Analog's solution, ISPs won't need as big a space to put in all their equipment," says Will Strauss, president of Tempe, AZ-based Forward Concepts, a consulting firm that offers electronics market research and strategic product-

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planning services. "The chip allows more channels per rack, with less cooling required, which lowers the power consumption," Strauss notes that other chips, such as Lucent's DSP-16000 and Texas Instruments' TMS-320C6201, both of which are slated to ship in volume in 1998, will compete with Analog's chip. Rockwell is likely to deliver products based on the ARM and other microprocessors.



Analog Devices' ADSP-21mod870 (actual size) puts the functionality of a modem on a single chip.

Because Analog's current chip is a digital-only solution, it is applicable only to ISPs and central offices connected to a T1, ISDN, or other digital line. But sources say Analog is working on another version of the chip that contains an on-board codec to let it talk to analog lines, providing a solution for makers of modems for end users. Such a chip, which will allow less expensive high-performance modems that consume less power, would be especially interesting for manufacturers of modems for notebooks.

—Dave Andrews

DVD Remains a Moving Target

As rival companies squabble over standards, some hardware and content manufacturers are adopting a wait-and-see attitude toward rolling out products based on Digital Versatile Disc (DVD), the technology that may one day replace the CD-ROM. Despite varying form factors and ever-increasing spin speeds, the ubiquitous CD-ROM drive has been a stabilizing and unifying influence in the computer world. But as technology makers shift alliances to match their latest DVD vision, an emerging standards war threatens what should have been an orderly transition to the emerging DVD standard.

The original CD-ROM format put a capacious 650 MB on a single cheap, easily produced disc. Acceptance of CDs was initially hampered by high hardware prices and meager software support. However, CDs eventually became the computer industry's preferred medium for software and multimedia content distribution.

Mike Weiss, vice president of entertainment and business development at Sirius Publishing, a Scottsdale, AZ-based CD medium producer, says CD-

ROMs are so well entrenched that it will be at least five years before they are supplanted by the newer technology. "It will be years before all machines ship out with DVD as standard equipment," Weiss says. "Until DVD can replace a VCR, I don't see widespread consumer acceptance."

It took several years for the industry to make the leap from using CDs at the desktop to also authoring them at the desktop. CD Recordable (CD-R) discs, which appeared in the late 1980s, use a coating of temperature-sensitive dye. To write data, a laser in the drive heats spots on the dye layer, changing its color and therefore its reflective properties. Although scattered cases of incompatibility exist, often due to poor calibration of laser power during writing, the read laser of a standard CD-ROM drive can generally read CD-R discs.

The allure of mastering your own discs using CD-R was undeniable, but it was not without its disadvantages. The medium was costly, and a single mistake rendered a disc unusable. CD Rewritable (CD-RW) drives have emerged to address these issues.

CD-RW drives use phase-change technology to alter the reflectivity of spots on the disc surface in a reversible way. The alloy used to coat CD-RW discs can withstand up to 1000 write-erase cycles, making CD-RW a good candidate for backup and data exchange.

But CD-RW is not without its problems. The reflectivity of a CD-RW disc is low—an unavoidable characteristic of its rewritable coating. As a result, most existing CD-ROM and CD-R drives cannot read CD-RW discs.

A new MultiRead standard specifies higher-gain read circuitry and will allow future CD drives—expected to include most DVD drives—to read CD-RW discs. Although CD-RW discs will work primarily in CD-RW drives, the drives will also write to CD-R media, letting CD-RW owners create media compatible with CD-R and CD-ROM devices.

Increasing confusion in the CD market is as simple as introducing an entire new family of standards. DVD-ROM is being promoted as a panacea for both publishers and consumers. Originally envisioned as a unifying standard that

Bug of the Month

Your Tax Dollars at Work



Many of us can lose or throw away a software user's manual and still be able to work without it. However, when a government agency has no user's manual, the price can be enormous.

In an effort to cut Medicare fraud and waste, the Health Care Financing Administration (the HCFA is the federal agency that administers the U.S. Medicare and Medicaid programs) contracted GTE to build a single, integrated claims-processing system. Millions of dollars later, the job has been terminated. In a speech before the House Committee on Commerce, Bruce Merlin Fried, director of the HCFA's Center for Health Plans and Providers, said the job has so far proven to be impossible due to a "lack of documentation" of the current system. The current claims-processing system involves 80 contractors

using unique, proprietary, or idiosyncratic software to process 800 million claims annually, querying eight operational systems at 34 data centers.

The job had an unstable history from its beginning in 1994. GTE won the bid to re-engineer the system for \$19.4 million, but it quickly realized that it hadn't fully fathomed the complexity of the task and renegotiated the contract for \$92 million in September 1996. The HCFA expected the system to be finished in May 2000 for a total of \$102 million. As of September 9, 1997, the HCFA estimated it had spent \$41 million until the contract was terminated on August 15, 1997.

The most positive result of the fiasco is that, for \$41 million, the HCFA now has "gained a detailed set of specifications for a managed health-care process," according to a spokesman for Medicare. So, the next time someone tries the same job, they might actually know what lies ahead. —Jason K. Krause

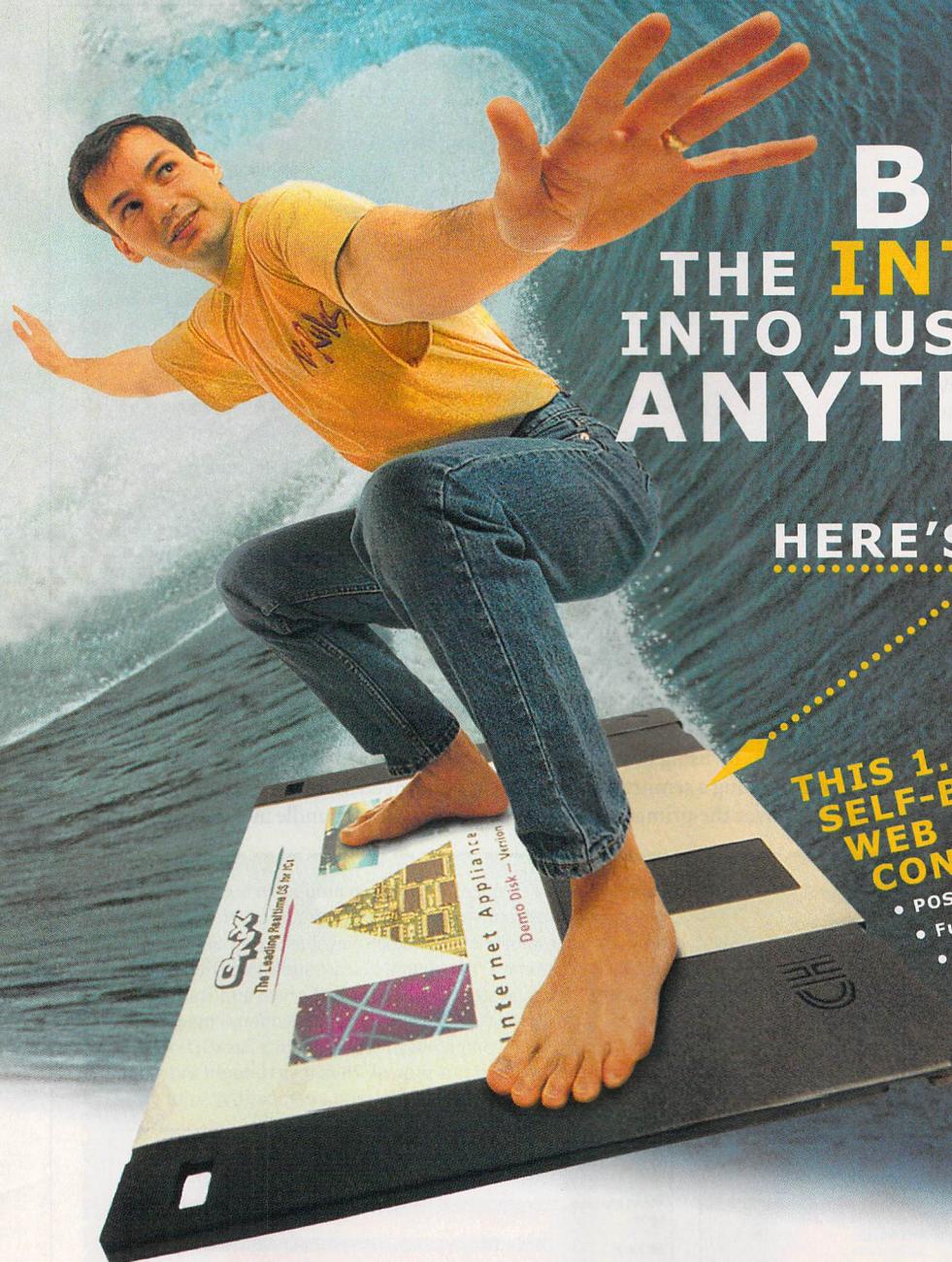
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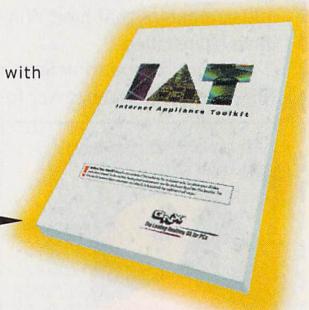
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would gather previous CD technologies under its wings, DVD standards are now more fractious than CD standards have ever been.

Vadim Brenner, engineering division product manager at Plextor, says the lack of firm standards is enough to delay his company's entry into the DVD market. "Plextor hasn't come out with a DVD drive," Brenner said, "and won't until the hardware requirements stabilize."

In its single-sided form, a DVD can hold 4.7 GB. A two-layer version boosts a DVD's capacity to 8.5 GB, doubling to 17 GB for a double-sided version—enough to hold 8 hours of feature video on a disc the same size as a standard CD. But some medium producers question the need for such a standard at the desktop.

"I can't see the difference between having *Star Wars* on VHS or DVD," Weiss says. "Promoting DVD's potential higher resolution and better video is setting early adopters up for a big disappointment."

A DVD drive is built around a laser that produces shorter-wavelength light than standard CD drives. The shorter wavelength lets the laser produce smaller

Drive type	Drive cost	Medium cost (retail)	Availability	Best applications
CD-ROM	\$150 or more	Not applicable	Now	Software installation, networked and local database, multimedia, games
CD-R	\$350-\$800	\$4-\$5 each	Now	Low-volume data distribution, archival/backup
CD-RW	\$400-\$900	\$20-\$25	Now	Archival/backup, CD master development
DVD-ROM	\$379 or more	Not applicable	Now	Multimedia, games, movie viewing
DVD-R	Unknown	Unknown	Early 1998	High-capacity archival, multimedia authoring
DVD-RAM	Approximately \$500 or more	Approximately \$20	Late 1997 or early 1998	High-capacity archival, multimedia, video editing

spots. This, combined with tighter track spacing, yields the DVD's higher single-sided density. By using both sides of the disc and bonding a semitransparent second layer over the primary layers, DVD

capacity can be boosted to an impressive 17 GB.

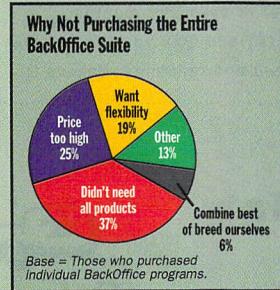
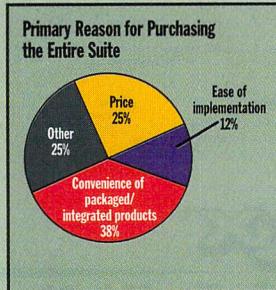
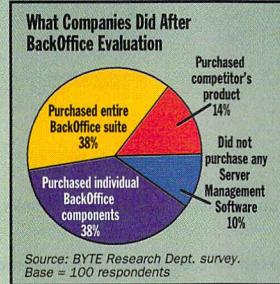
To take advantage of DVD content, you'll need more than just the drive. Typically, a DVD bundle includes a PCI video

Survey

SQL Server Suite Spot

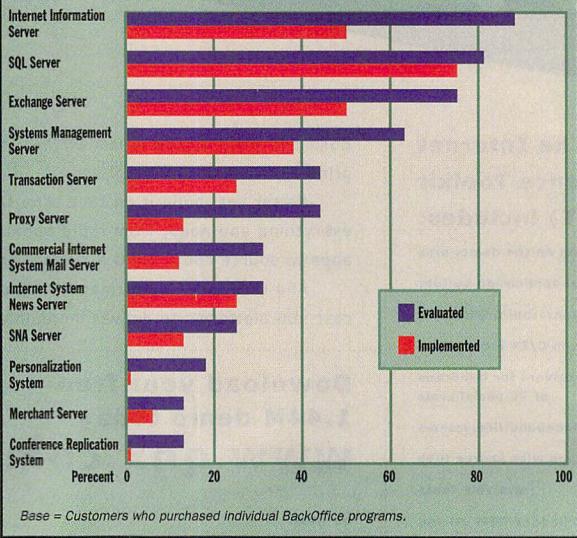
Convenience and price are the two leading reasons that companies purchase Microsoft's entire suite of BackOffice programs, while the leading reason companies give for not buying the entire suite is that they don't need all those components. In those companies that do implement individual BackOffice components, SQL Server is the application most often chosen, according to a recent survey performed by BYTE's research department of 100 companies that have Windows NT installed.

Internet Information Server (IIS), Microsoft's Web server for



NT, was the most frequently evaluated product in the suite by customers who chose individual BackOffice programs. However, even though it was evaluated the most, IIS was chosen only 50 percent of the time by customers that bought at least one BackOffice product. Exchange Server, Systems Management Server, and Transaction Server round out the top five individual applications implemented most frequently. Of companies who purchased a BackOffice competitor's product (chart not shown), 79 percent bought individual products, and only 21 percent went with a competitive suite.

Individual BackOffice Products Evaluated, Implemented



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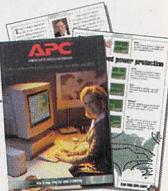
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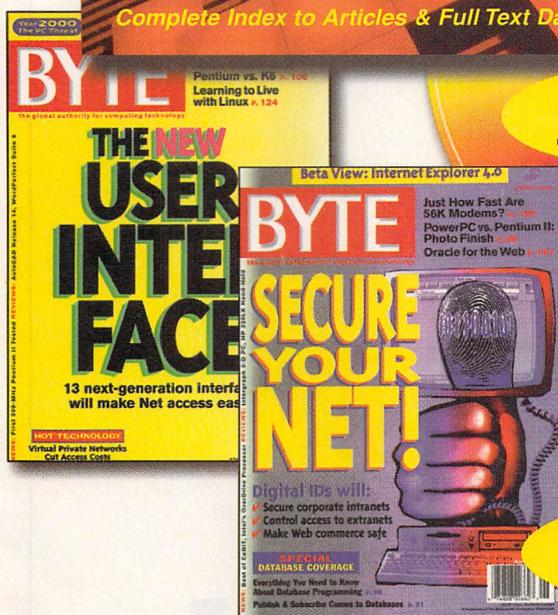
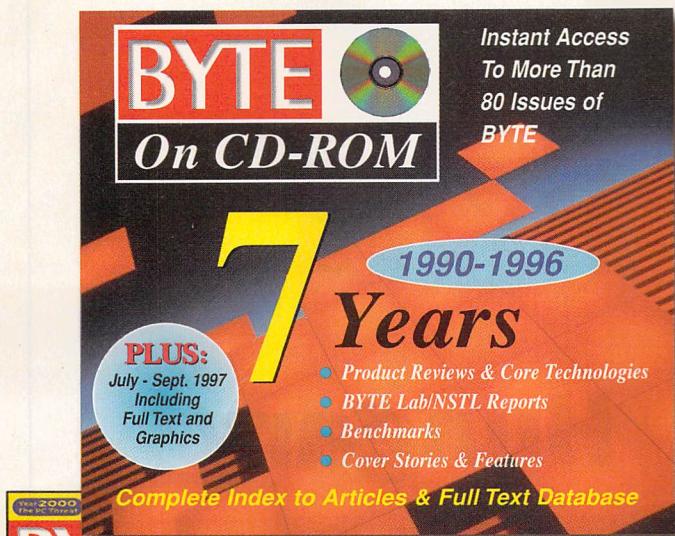
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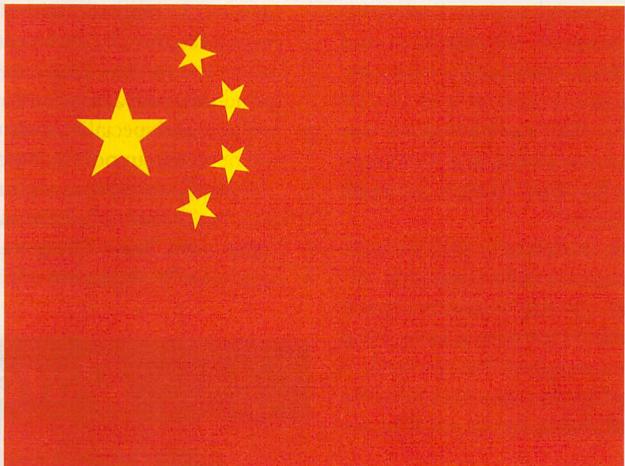
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card with the specialized hardware needed to decompress the MPEG-2 video signal coming from the disc. The decoded video goes directly to your computer's monitor, bypassing your CPU and regular video card. High-end systems require decoding of Dolby AC3 audio, which provides sound in six dimensions (five speakers plus a subwoofer).

The rush to market and the shifting nature of DVD technology are making manufacturers edgy and casting consumers as potential victims. Early DVD drives, for example, are unable to read CD-R discs. More recent drives overcome this limitation and claim to read CD-RW discs as well. "If your DVD drive was designed with one pickup and won't read CD-R," says Brenner, "there's not much that can be done."

Like CD-ROM before it, DVD technology is evolving toward a rewritable version—but at a greatly accelerated pace. Currently, the DVD Forum is attempting to negotiate a standard, but the battle is furious. Nothing less than control of the industry and sizable future royalties are at stake.

DVD Recordable (DVD-R) is a write-once technology with more than passing similarity to CD-R. DVD-R's use of a wavelength-sensitive dye means it will probably suffer incompatibility problems with future short-wavelength DVD drives. When you combine that uncertainty with high hardware and medium prices and a reduced capacity of 3.8 GB per side, DVD-R may have a mercifully short marketable life.

A DVD consortium was championing, with some success, a 2.6-GB-capacity rewritable format dubbed DVD-RAM and based on phase-change technology. But recently, Sony and Philips Electronics have broken away and, joined by Hewlett-Packard, Mitsubishi Chemical, Ricoh, and Yamaha, are pursuing an independent DVD rewritable format.

This new format, referred to unofficially as DVD+RW, will store 3 GB on a single side. This split, combined with the copyright concerns of content publishers and high hardware costs, is likely to delay rewritable DVD for a few more years.

If you're considering buying into this technology, you should proceed carefully. It will be an expensive battle to stay at the edge of current technology.

—Robert L. Hummel

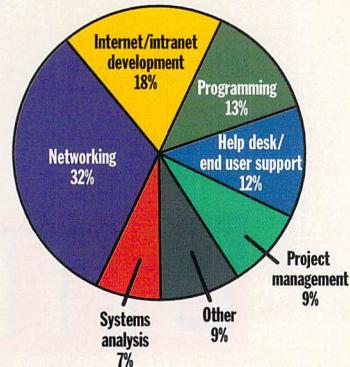
Networking Leads Among Hottest IT Jobs

Networking-related jobs are experiencing the most growth within IT departments, according to a recent survey of CIOs. According to a survey conducted for RHI Consulting of 1400 CIOs in U.S. companies with 100 or more employees, the jobs most in demand fall under the networking category and include network administrator, network manager and specialist, systems analyst, and network support technician.

Overall, networking captured 32 percent, but certain industries saw an even higher need. Networking was the leading choice by 46 percent of CIOs work-

ing in the transportation industry. Internet/intranet developers were in particularly high demand in the retail sector, capturing 25 percent of the vote, trailing networking by just 3 percent.

Jobs in Highest Demand



Networking ranks highest.

Datapro Report

ADSL Vendors Work for Interoperability

Recent agreements among leading vendors of ADSL-related (Asymmetric Digital Subscriber Line) technology will help pave the way for widespread deployment of advanced communications services over existing telephone lines. The result of these cooperative efforts should help assure potential customers that equipment they buy from one vendor will interoperate with equipment from other vendors.

Early this year, Alameda, CA-based Ascend Communications, a provider of remote-networking solutions, announced the licensing of ADSL discrete multitone (DMT) technology from broadband communications provider Aware (Bedford, MA). In late September, San Jose, CA-based Amati announced a cross-licensing agreement to share patented intellectual property and conduct interoperability testing of designs based on those patents with Alcatel. Product compatibility and joint interoperability testing are crucial to widespread deployment of ADSL services to meet telecommunications industry requirements for reaching the small office/home office (SOHO) and residential markets.

ADSL has gained new life as a high-speed Internet-access solution, after plans by telecommunications providers to use it for video-on-demand applications founders. ADSL is easier and cheaper to deploy than

ISDN, as well as faster, supporting speeds of up to 6 Mbps and beyond downstream (to the user) and up to 640 Kbps upstream. Initial ADSL signal-modulation implementations were based on carrierless amplitude and phase modulation (CAP), but DMT solutions now have the momentum, thanks in part to DMT's adoption as an ANSI standard.

In many initial commercial ADSL rollouts, the communications service provider provides the necessary equipment that its customers will need, but ADSL vendors say product interoperability will be necessary once customers start buying equipment in retail channels. "If it works in the Boston area, and you are transferred, you want to know that your ADSL modem will work elsewhere," says Jim Bender, president and CEO of Aware. "We are well on our way to seeing interoperable equipment."

Says Michael Newson, spokesman for Richardson, TX-based Alcatel USA: "We all want to build products to this [ANSI] DMT standard, so we don't get into the situation faced by phone companies with ISDN, where too many problems with incompatible equipment at the central office and home level stymied acceptance and frustrated consumers." —Carol Skvarla. For information on reports from Datapro, a business unit of the Gartner Group, contact 609-764-0100; fax: 609-764-2814; or <http://www.datapro.com>.

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Book Reviews

Avoid the Technology Trap and Prosper

How listening to customers can sometimes cost you serious money.

In the Age of Infoglut, it's not enough for corporate IS to impose a powerful, high-bandwidth architecture for data delivery. If knowledge workers are already overloaded, additional bandwidth will only make the problem worse. What enterprises really require—and so often lack—is an integrated strategy of information management. Thomas Davenport proposes this type of holistic approach in his latest book, *Information Ecology: Mastering the Information and Knowledge Environment*.

Refreshingly, Davenport devotes only a single chapter to software/hardware architectures. He points out that information technology (IT) spending in the U.S. alone has approached 3 trillion dollars over the last decade, but "information—or at least the effective use of it—has not improved at the same rate as technology spending." Clearly, we need a better way for human networks to process the information already available.

Dynamics such as politics and human behavior often get short shrift in other works on information management, but Davenport emphasizes the role of corporate culture. He exposes the various political structures that disseminate a corporation's most vital data, but he does not necessarily promote one hierarchy over another. Any of the models—from a highly centralized "monarchy" to a less centralized "federalism"—could work successfully for a particular organization. The important point is "matching your organization to the political structure that best suits it," instead of avoiding the difficult issue altogether.

Davenport also evaluates tactics for reengineering the information environment, for selecting an information staff, and for formulating an integrated information strategy. The case studies are well researched and relevant.

More so than ever before, information is power in today's service economy. To remain competitive, an enterprise must manage its critical information efficiently and get the knowledge into the heads of the people who need it. But before you throw more technology at the problem, read *Information Ecology*. It will get you thinking constructively about the challenges ahead.

Clayton Christensen's *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail* tracks corporations that did have a firm grasp of critical market data. Corporations that listened closely to customers, systematically evaluated their competitive markets, and built a commonsense business strategy. Corporations that seemingly did everything right—and failed. It is the dilemma of disruptive technologies.

Using the disk drive industry to illustrate his theories, Christensen shows how well the leaders in a particular disk drive market handled the implementation of *sustaining technologies*—technologies that improve, incrementally or radically, the performance of established

products—while the same market leaders crumbled when faced with disruptive technologies. A disruptive technology may debut with performance that's inferior to the status quo but enables new markets and applications.

When Seagate Technology introduced a 5½-inch disk drive in 1980, leaders in the 8-inch-drive market did not adopt the smaller format, because it could not deliver performance enhancements to their existing minicomputer customers. They did not see the coming of the desktop computer market, a market that demanded the form factor and ruggedness of the 5½-inch technology. Vendors of 5½-inch drives captured the nascent desktop market and, when the format reached the performance and capacity requirements to move upstream, they took over the minicomputer market as well. Of the four leading vendors of 8-inch drives, only one survived as a player in the 5½-inch market. These companies were not mismanaged. They invested in market research and listened to customers—the wrong thing to do in the context of disruptive technology.

This example is certainly no anomaly. Christensen cites case after case of leading firms responding successfully to sustaining technologies while failing miserably when faced with disruptive ones. And while the life cycle of products in the disk drive industry ("the closest things to fruit flies that the business world will ever see") make for a convenient gauge of the phenomenon, disruptive technologies affect any firm, from disk drive vendors to motorcycle makers to catalog retailers, that grapples with new product technologies.

So how does a company respond to disruptive technology? Christensen offers some solid suggestions. When developing a disruptive technology, don't assume a specific market for it. You can't evaluate a market that has not yet emerged. Also, small companies (market entrants or spin-offs of large organizations) seem best for deploying disruptive technologies. The company must be nimble enough to respond quickly to a developing market.

Not only are small companies more flexible, but emerging markets can't satisfy the growth needs of big corporations. Consider Apple and its introduction of the Newton. For Apple, sales of the Newton could not satisfy its voracious appetite for growth. Sales were considered a flop. For a start-up, though, the 140,000 units sold in 1993 and 1994 would have constituted a successful launch, perhaps garnering an influx of investor support. Interestingly, Apple appeared ready to create a spin-off for the Newton technology until Steve Jobs recently pulled the company back into Apple.

The Innovator's Dilemma teaches us when not to listen to our customers, but instead how to pursue a nonexistent market that promises lower profit margins and greater risk.

Stanford Diehl is a frequent contributor to *BYTE* magazine and a former director of the *BYTE* Lab.

Information Ecology:
Mastering the Information and Knowledge Environment
by Thomas H. Davenport, Oxford University Press, 1997, \$29.95, ISBN: 511168-0

The Innovator's Dilemma:
When New Technologies Cause Great Firms to Fail
by Clayton M. Christensen, Harvard Business School Press, 1997, \$27.50, ISBN: 0-87584-585-1

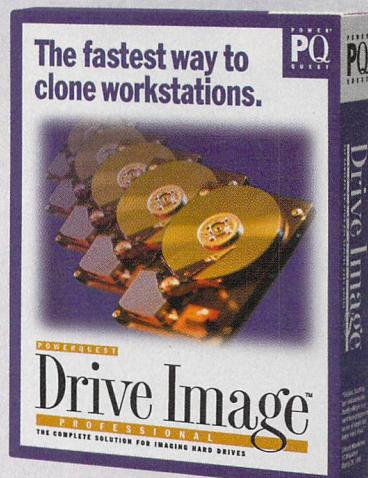
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Blasts from the Past

Years ago in BYTE

5

Gateway's 66-MHz 486DX2-based PC with 8 MB of RAM, a 14-inch monitor, and a 500-MB hard drive cost \$3795. Microsoft's Video for Windows helped move PC video more into the mainstream. Apple's new Duo Macs could be a notebook or a desktop.



Years ago in BYTE

10

Apple's new HyperCard offered an easy-to-use English-like scripting language that allowed nonprofessionals to write useful programs.

Years ago in BYTE

15

The \$3950 Athena I CP/M-based portable computer ran on two 2.5-MHz NSC-800 processors, had 68 KB of RAM, 512 KB of mass storage, and, at its 15-pound weight, was truly portable. The personal computer as coinless arcade? We devoted eight pages to popular computer games. PC graphics have come a long way since the early days of Luke Skywalker.



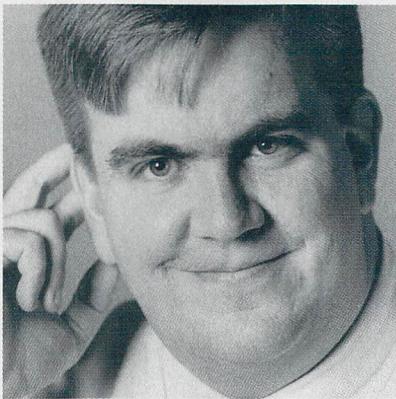
Years ago in BYTE

20

Computers and *Star Trek*: Will computers be able to retrieve an answer to any factual question in a matter of seconds in the twenty-third century? Probably. As the article said, science fiction often predicts scientific fact.

A Voice for Java Developers

Rick Ross, founder of the Java Lobby, discusses the promises, pitfalls, and personality conflicts surrounding Java.



BYTE: *What is the Java Lobby, and what are its goals?*

Ross: We are an organization that formed because we perceived a need to speak from a developer's perspective on issues that are pro-Java and pro-developer. We welcome everyone that has an interest in Java, both users and developers, to offer support and to join us in developing this pro-Java and pro-developer message. I hope that the emergence of a strong voice, a clear voice for the development community, can level the playing field and reduce some of the rhetoric. I want Java to succeed, and I want Java developers to have the maximum success.

BYTE: *How does the Java Lobby approach vendors?*

Ross: We have had direct contact with most of the major vendors and have spoken to them about who we are and what we stand for. We told them we want wide-open, two-way communication to speak with them as peers, to represent the developer's community.

BYTE: *How do you perceive the rift between Microsoft's AFC and Sun's JFC in the developer community? [Editor's note: Just after this interview, Sun filed a lawsuit charging Microsoft with breaching its contractual obligation to deliver a compatible implementation of Java technology with its products.]*

Ross: I think it speaks to a deeper

underlying issue, which is the way that the dialogue concerning Java has become polarized by the antagonism between Microsoft and Sun. Today, AFC versus JFC looks like the big issue. Frankly, I wish they would stop pitting one against the other. I wish they [Sun and Microsoft] would cut that out and give us both. Give us freedom of choice. That's what it ought to be about.

BYTE: *What will happen if Java disintegrates into vendor-specific versions, similar to what happened to Unix?*

Ross: It would certainly be a dreadful thing. The key thing that ignites all the enthusiasm about Java is the shared belief that we can achieve meaningful portability.

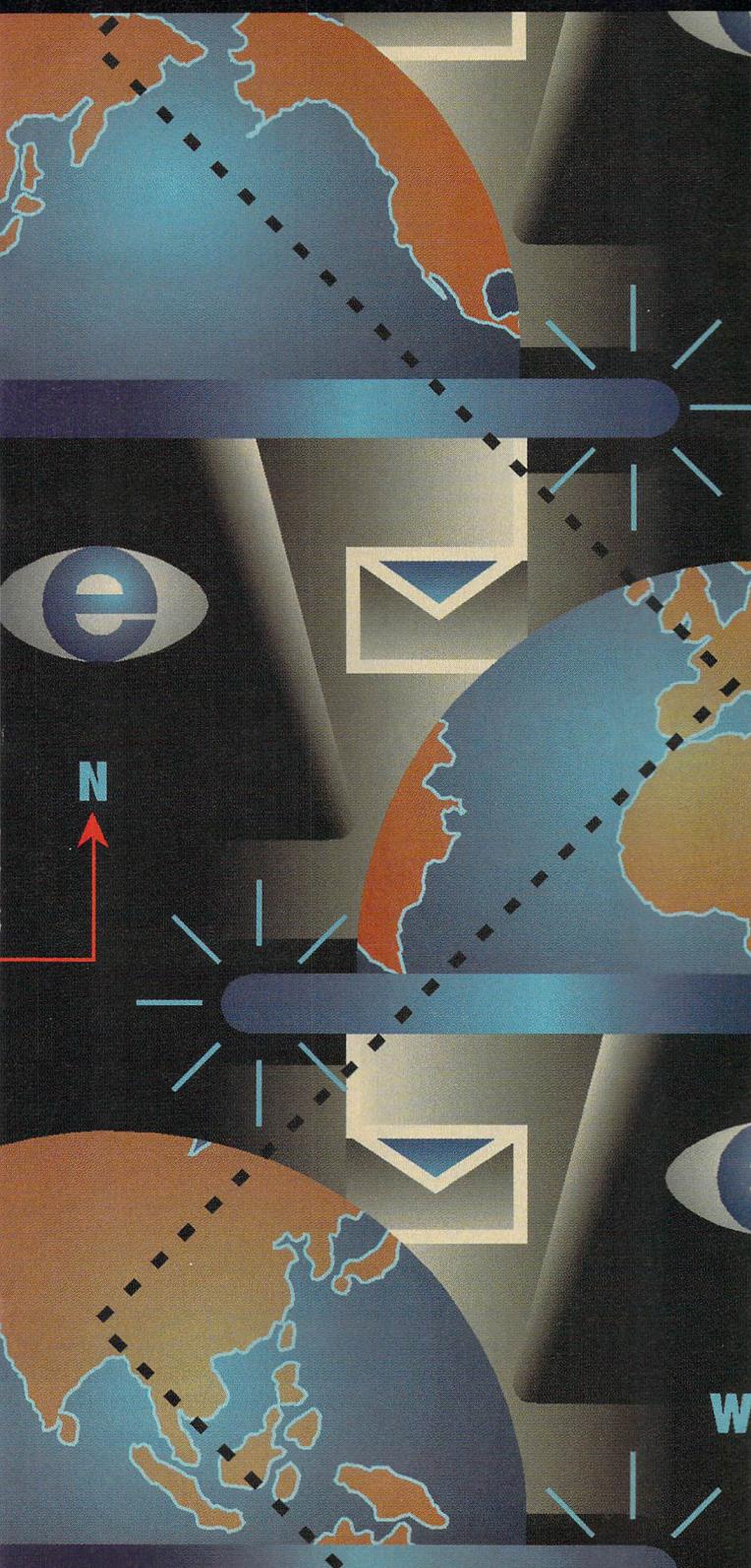
BYTE: *Do you think it's important that the Microsoft/Sun rift be healed?*

Ross: I think it would be a regrettable development if Microsoft continues to hold on to this apparent position that will fragment the emergence of a meaningful portable standard. And I hope that will not happen. If it's true that developers really want to see Java succeed, I really hope Microsoft will work with the developer community to make that happen. I hope it understands that it is in its interest as well as in our interests. Everybody knows that if Java succeeds and "Write once, run anywhere" does come true, you'll see a lot of developers write once, run mostly on Windows. Microsoft stands to win so much. It could win the loyalty of a huge number of developers and users by deciding it supports the same goals we care about, and by setting aside its concerns that in some way or another Java will open the door to some kind of economic competition that it doesn't feel is advantageous to itself.

You can get more information on the Java Lobby at <http://www.javalobby.org>.

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More Storage for Less Money

Large 9.1-GB hard drives enter the mainstream. Page 44IS 3

Digital-Audio Broadcasts

Products and services are moving out of the research labs.

Page 44IS 3

Your Only Inbox

More companies embrace unified messaging systems. Page 44IS 9

Next-Generation Notebooks

Mobile PCs have better graphics and faster processors.

Page 44IS 13

C++ to Java

A program converts C++ applications into Java.

Page 44IS 18

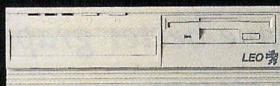
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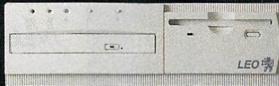
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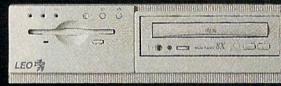
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Drives Get Bigger, Faster, Cheaper

9.1-GB drives spinning at 7200 rpm will soon enter the mainstream.

Despite many competing technologies, hard disk drives continue to hold their dominant position as the medium of choice for data storage. The price of hard disks continues to plummet, while capacity and performance climb upward. Seagate and Quantum are expected to ship 9-GB Ultra2 SCSI drives in mid-1998. The 3.5-inch-factor drives, which stand just 1 inch high, spin at 10,000 rpm.

The higher the rotational speed of the disk drive motor the greater the data transfer rate, and the lower the seek and latency times when the head switches tracks. Today, most hard disks spin at 5400 rpm, with higher-end models attaining a speed of 7200 rpm. The Seagate Barracuda, Quantum Atlas, and Micropolis Tomahawk 7200 drives have become popular in multimedia applications such as digital motion pictures.

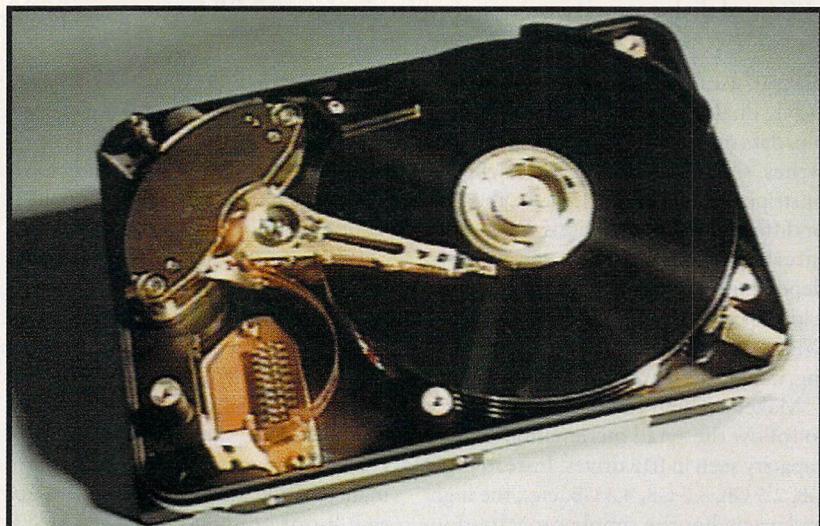
Seagate is already shipping its first 10,000-rpm disk drives, the Cheetah family. With formatted data transfer rates peaking at 16.8 MB per second (around 40 percent better than top 7200-rpm hard drives), and prices around 40 percent higher than equivalent 7200-rpm offerings, these 4.5- and 9.1-gigabyte drives are currently limited to niche market applications. Early next year, however, Seagate will sell a new drive, the Medalist Pro 9140, that has a 9.1-GB capacity and spins at 7200 rpm. Street price will be about \$495, according to Denise Lippert, product marketing manager.

Not all agree that high-end 10,000-rpm drives are a viable business right now. David Rawcliffe, marketing director of Quantum Asia-Pacific, says Quantum will offer 10,000-rpm models in mid-1998, when 10,000-rpm drives might have 15 percent of the high-end hard disk market. Quantum's first 10,000-rpm entries are expected to hold 9 GB and 18 GB, with

either Ultra2 SCSI or Fibre Channel interfaces. Rawcliffe also expects 10,000 rpm to remain the top hard disk rotational speed until early next decade.

Magnetoresistive (MR) heads, used by IBM and Quantum, helped achieve the next level of capacity by separating the read and write functions into two physi-

bits per square inch, is expected to arrive next year in some 3.5-inch drives with capacities well above 10 GB. Western Digital is already shipping UltraATA IDE devices with 2.16 GB formatted capacity per platter (6.4 GB for a three-platter hard disk) using MR head technology. In 1998, MR heads are expected to overtake the



Seagate's new 9.1-GB drive is expected to sell for around \$495 when introduced early next year.

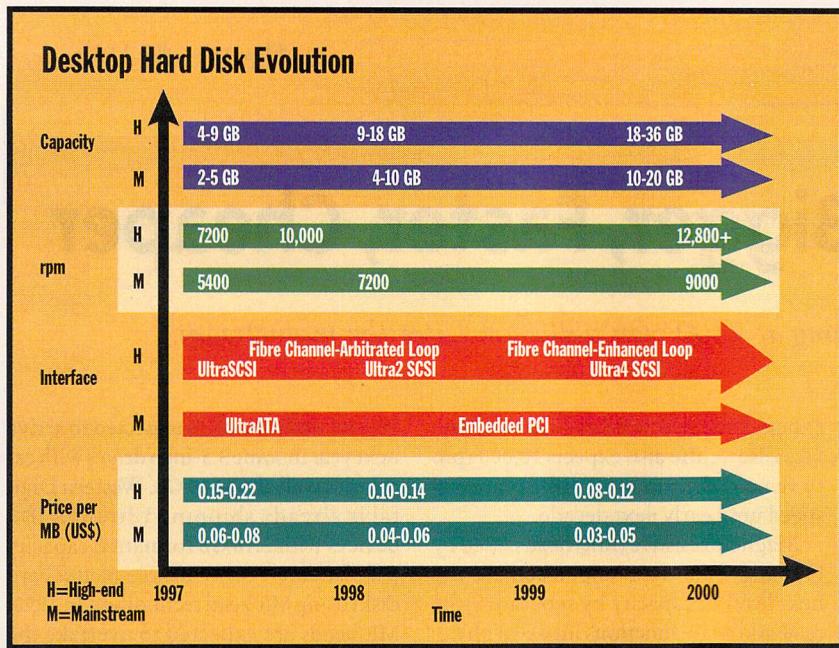
cally distinct heads. An inductive head, optimized for writing information, is integrated with the MR structure optimized for reading. MR heads are usually coupled with partial response maximum likelihood (PRML) channel recording for resolving data pulses from the disk surface. While the initial troubles in manufacturing MR heads limited their use to very high-end drives, the yields have improved in the past two years. Major vendors like IBM, Quantum, and Seagate use them in many mainstream IDE drives.

The next step, Giant MR (GMR), enabling recording density in tens of giga-

old inductive ones in terms of number of units shipped, analysts say.

Besides GMR and improvements to PRML, like IBM's PRML with digital filtering, new technologies like multilevel decision feedback equalization (MDFE) are expected to help achieve even higher capacities. Developed by Singapore-based Data Storage Institute, MDFE is expected to surpass PRML and its derivatives in recording density and performance.

On the high end, dual-head parallel drives, pioneered by Seagate, didn't make it in the market. Seagate dropped its 2-GB Barracuda 2HP two years ago, with no



PC hard disk capacity is expected to climb to 36 GB by the year 2000.

plans to use the technology in the future. While dual-head parallel operation doubles data transfer speed for both reads and writes, similar speedups can be achieved by striping two identical drives on the same or different SCSI connections. Data can be interleaved on a word or sector basis, depending on whether your target application is graphics- or database-oriented. Windows NT directly supports disk striping, joining the drives into a single volume.

Makers of high-end drives do not need to follow the small incremental steps in capacity seen in IDE drives. Instead of 2.1 GB, 2.5 GB, 3.2 GB, 4.3 GB, etc., the high-end arena has the simple capacity-doubling rule: 2.2 GB, 4.5 GB, and 9 GB. The 18-GB Quantum Atlas III is presently the highest-capacity 3.5-inch drive.

UltraSCSI, in its 20-MBps 8-bit and 40-MBps 16-bit versions, is now the dominant high-end mass storage interface. Many high-end drives are available in the most popular versions of this interface, including combinations of narrow, wide, single connector attachment (SCA), and differential UltraSCSI. Early next year, volume shipments of the first Ultra2 SCSI drives with new LVD-Link (low voltage differential) transmitter technology will start. The 16-bit version of Ultra2 SCSI not only doubles the transfer rate to 80 MBps, it also increases the maximum cable length from 1.5 to 12 meters. The first PCI controller to provide Ultra2 Wide SCSI with LVD-Link

is Symbios's 53C895 Ultra2 Wide PCI/SCSI I/O processor. The company is expected to offer a dual-channel Ultra2 SCSI processor early next year on a 64-bit PCI bus, the follow-on to its 53C876 dual-channel Ultra Wide SCSI PCI processor.

For the next year, there are more design improvements scheduled by the ANSI XT310 committee, including compact packaging, tripled connector density, and "smart silicon." With Ultra4 Wide SCSI, bus bandwidth will increase to 160 MBps.

The Fibre Channel-Arbitrated Loop (FC-AL) provides serial interface performance of 100 MBps per loop, with up to two loops connected to each storage device. This unprecedented performance rate can be sustained on links up to 10 kilometers long, with as many as 126 devices in a single chain. Adaptec and Symbios were among the first to offer FC-AL PCI host adapters earlier this year.

Quantum's Rawcliffe says the 1998 high-end focus will still be on Ultra2 SCSI with LVD, as the performance difference between it and FC-AL is not so drastic, and there will still be around a 20 percent price differential between otherwise identical drives in Ultra2 SCSI and FC-AL versions. Also, FC-AL controllers will still be substantially more expensive, even with single-chip implementations like the Adaptec AIC 1160 and the Symbios FC920. Adaptec product manager Adam Zagorski states that the company expects "two distinct

markets to develop for Ultra2 SCSI and Fibre Channel. People will use Ultra2 to support their legacy SCSI drives."

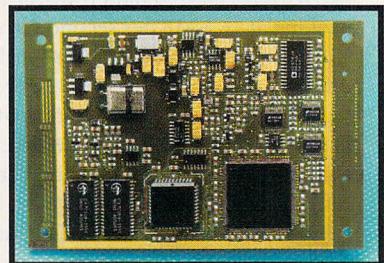
A year ago, Seagate and IBM agreed to merge Seagate-backed FC-AL and IBM-backed Serial Storage Architecture (SSA) into one serial storage interface standard dubbed Fibre Channel-Enhanced Loop (FC-EL), combining SSA reliability and FC-AL performance. It could become the dominant long-term high-end mass storage interface, with performance moving toward 800 MBps and beyond. Like FC-AL, FC-EL is both a network and a storage interface standard, supporting Internet, ATM, and SCSI protocols, among others. The first FC-EL products are expected in 1999.

But don't expect high-end drives that predict and warn you of their failure. Self-Monitoring, Analysis, and Reporting Technology (SMART) is not planned for most workstation and server systems next year.

-Nebojsa Novakovic

Web and Radio Broadcasting

The World Digital Audio Broadcasting committee recently established standards for transmitting data over the air. And now, products based on those digital audio broadcasting (DAB) standards are starting to emerge. DAB enables the transmission of program-associated data and information



First DAB receiver cards for your PC will be available next year.

services such as traffic and weather updates. Its most compelling use, however, could be Web datacasting. Trials of DAB datacasting have been completed in The Netherlands, Finland, and Germany. Commercial services are already running in Sweden and the U.K.

DAB inserts MPEG Layer 2 compressed multimedia data into the audio

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stream. A new Multimedia Object Transfer (MOT) protocol controls broadcasting of data objects. These objects can include HTML documents, bit-map graphics, MPEG audio and video files, and also zipped executables. According to the German DAB-Platform group, Java applets may soon be part of the MOT data type list as well.

Because of its data transfer rates of up to 1.2 Mbps, many European Internet users might eventually consider DAB Web datacasting as an alternative to Internet access via phone lines. A DAB receiver plug-in PC card, developed by German manufacturer TechniSat (Daun, Germany), is slated to be on the market by June of 1998. In addition, developers such as Roke Manor Research (Romsey, U.K.) have already launched a Windows 95-based DAB receiver software development kit.

While audio features will drive the mass market for DAB in the near term, manufacturers and service providers say that multimedia and data services will eventually be even more important. In contrast to GSM, for example, DAB was designed with data services in mind and is backed by media-savvy broadcasters; GSM data was introduced and developed primarily by telcos who are just now beginning to build up the know-how and strategic alliances required to offer useful and compelling multimedia services.

Interactive DAB services are the subject of a number of ongoing trials. As with digital video broadcasting (DVB), which enables broadcast of data in addition to digital TV, European developers are working to commercialize a viable back channel for interactivity.

One possibility may be the GSM cellular phone network. For example, in the pan-European Multimedia Environment for Mobiles (MEMO) project, conducted by more than 20 research and telecommunication industry participants, DAB forms the broadband channel with data rates of up to 1.8 Mbps for downloading. The back channel runs over GSM at 9.6 Kbps, which is sufficient for users' interactions.

Experts say that projects like MEMO have initiated a new generation of integrated DAB and GSM chips. Expect first prototypes from manufacturers Bosch and Hitachi to be available for testing next year.

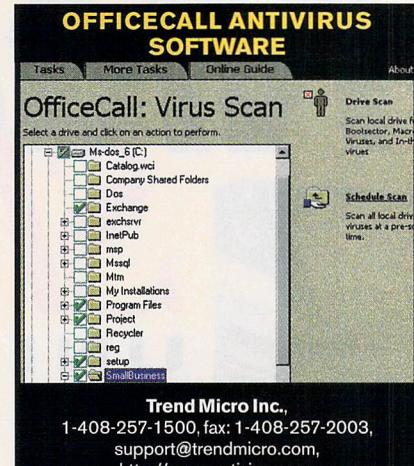
-Valerie Thomson

Kill Macro Viruses

As the use of the Internet and e-mail increase, so do virus infection rates. In particular, users are running into an escalating number of so-called macro viruses, bits of malicious code that are hidden in e-mail attachments or in document files. The threat begins the moment you view a Java-enabled Web page.

Steve Chang, CEO of Trend Micro, an antivirus software developer in Taipei, says that more and more corporations are under attack from hostile applets. These programs use Sun Microsystems' Java and Microsoft's ActiveX scripting languages to perform a variety of tasks without the user's knowledge. The rogue ActiveX controls and Java applets, after gaining access to a user's hard disk, execute useless routines, clog RAM, and steal CPU cycles.

Trend Micro's OfficeCall is one of the



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OfficeCall: Virus Scan

Select a drive and click on an action to perform.

Drive Scan: Scan local drive for Bootsector, Macro Viruses, and In-File Viruses.

Schedule Scan: Scan all local drives for viruses at a pre-set time.

Trend Micro Inc.,
1-408-257-1500, fax: 1-408-257-2003,
support@trendmicro.com,
http://www.antivirus.com

first antivirus software programs that provides security for both ActiveX and Java components, according to Trend. Using the vendor's patented on-the-fly blocking mechanism, the software can selectively filter Java applets and ActiveX code from unknown FTP- and HTTP-borne viruses

The Next Generation of Web-Enabled TVs

European and Japanese TV manufacturers such as Thomson, Metec, Daewoo, Sanyo, Philips, Nokia, and Sharp recently showed the latest versions of their Web-enabled TVs. Although slightly different, all feature powerful mainstream processors such as the ARM 7500 or Pentium, 33.6-Kbps modem, easy-to-use software for e-mail, as well as a Web browser. They also share list prices of DM 6000 and up.

Simultaneous viewing of Web pages and TV programs (called "picture-in-picture"), infrared keyboards, and ports for printers and mice seem to be the essential components of this generation of devices. However, unlike Nokia's prototype set-top box called Mediastreamer, none of these TV hybrids includes an Ethernet card for directly accessing an interactive cable service.

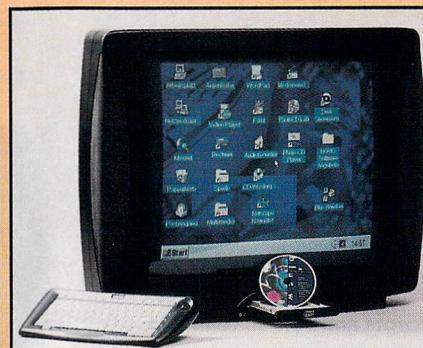
The model built by OEM Metec (Karlsruhe, Germany) is one of the few that integrates a

complete Windows PC in a TV set, without the need for a separate set-top box. It is based on a Pentium 133 or 166 processor and has a 1.2-GB hard drive and is expandable to 32 MB of RAM. It also includes a sound card, CD-ROM drive, and an ISDN card or a modem.

The unit can be upgraded to function as a video-conferencing system with a wireless microphone, camera, and associated software. However, there's no special user interface for TV viewers who are not computer-literate. It's simply Windows 95 on your television.

Thomson Multimedia (Boulogne, France), on the other hand, is billing its new set-top box as a consumer network computer (NC). This unit has a 33.6-Kbps modem, plus smartcard and PC Card slots. The box is multimedia-ready, supporting Virtual Reality Modeling Language, Real-Video, Shockwave, and videoconferencing.

-Valerie Thomson



Web-enabled TV sets
for your living room.

right before they can reach the corporate gateway, the company claims.

OfficeCall also incorporates Trend's MacroTrap virus engine. This rule-based scanning technology complements pattern matching with more sophisticated algorithms to examine macro commands embedded in word processing and spreadsheet files and identify malicious code.

The Web-server-based software employs an innovative "push" technology. Instead of requiring each client to log on to the Net and execute time-consuming file downloads, virus pattern updates are pushed from your local Web server to individual clients, which interact with the server via HTTP and CGI. Remote configuration and remote log checking on the Internet also are supported. Users can download a test version of OfficeCall from Trend's site at <http://www.antivirus.com>.

—Stella Kao

New CMOS Image Chip

Say good-bye to conventional ISDN- or network-connected boardroom systems priced at \$7000. Say hello to new \$200 videoconferencing kits for notebook computers.

The enabling technology comes from ElecVision, Inc., of Taiwan, which has announced a solid array of CMOS image sensors based on its Asynchronous Random Access MOS Image Sensor (ARAMIS) technology. Unlike other single-chip CMOS sensors destined to eclipse traditional CCD sensors, ElecVision's solutions are specially redesigned to suit a wide range of innovative digital imaging applications, according to Ray Lin, company president.

ElecVision's CMOS image sensor is as small as a postage stamp and can easily fit into any ultrathin notebook, offering on one chip full-color, high-speed videoconferencing, A/D conversion, and image processing.

"We believe the technology will help

WHERE TO FIND

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India to Expand Web Access

After much dithering, the Government of India is set to allow private parties to become Internet service providers (ISPs) to compete directly against Videsh Sanchar Nigam Limited (VSNL), the monopoly ISP in the country. Although this announcement, made by the Department of Telecommunications earlier this year, says that license fees for the new ISPs will be waived for the first couple of years, it's not a real opening of the Indian Internet access market.

The predicament is that VSNL, which was nominated to provide the backbone infrastructure for the new ISPs, will still operate as an ISP. In addition, service providers are forced to go through VSNL's international gateways. This arrangement has earned a lot of criticism from the E-mail and Internet Service Providers Association of India (EISPAI) and from the Confederation of Indian Industry (CII).

"There seems to be no rationale behind it," says Padma Chandrasekaran, vice president of Internet and Services at Satyam Infoway, one of the founding mem-

bers of EISPAI. "VSNL's role is obscure." Both organizations advocate the entry of private players into all segments of Internet access provision, including backbone and international gateway services.

Despite these debates, several global telecom operators and national players

subscribers and 60,000 university users today). The revenue from Internet access is expected to gather at least \$60 million per year, according to some analysts. Electronic commerce on the Internet could generate an additional \$145 million.

However, if these estimates come true, VSNL

India Internet Infrastructure by the Numbers

Main telephone lines in 1996	14,450,000
Telephone density per 100 inhabitants	1.5
Number of Internet hosts in 1996	3100
Internet hosts per 100 phone lines	0.02
Number of PCs in 1996	1,400,000
Internet hosts per 100 PCs	0.22
Number of Internet users in 1997	100,000

Source: International Telecommunications Union

have already applied for private ISP licenses. The National Association of Software and Service Companies (NASSCOM) reckons that over 150 new ISPs will enter the scene by the end of 1997. According to EISPAI, the Internet subscriber base in India will touch 500,000 by the end of next year (compare this to VSNL's 40,000 commercial

might have problems trying to extend its current 35-Mbps backbone to cope with the new ISPs' demand for bandwidth. In addition, considering the shortage and poor quality of ordinary voice phone lines, Internet access via the public switched phone system could be a nightmare for customers and local telephone operators alike.

—U.L. Pai

raise the demand for real-time live video transmission," says Lin.

The ARAMIS architecture allows the image sensor to randomly access any individual pixel on the chip, essentially increasing the read-out speed and accuracy. This random pixel addressability (similar to common DRAM) provides added flexibility in applications involving image compression, motion detection, or target tracking. In comparison, CCD chips from other vendors must read the entire array of pixels at one time and synchronize the timing of the voltage applied to the electrodes.

Because the new chip has intelligent motion-detection capability, you don't have to supplement it with an image capture card in order to grab moving pictures. Proprietary video/audio compression and

communications software that enables 12 to 15 frames of live video per second is included.

The video chip is available in either black-and-white or color versions. A range of resolutions, including 176 × 144, 302 × 288, and 640 × 480, is also available. In addition to such immediate potential applications as a "digital camera on a chip," the company says, the new sensors will meet the demand for numerous applications in consumer products, including automated teller machines, mobile phones, and home monitor systems. ElecVision, a fabless semiconductor company, is currently bundling its CMOS design kit with its compression software for a number of computer companies in the U.S., Europe, Japan, and Taiwan.

—Stella Kao

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News & Views

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- VLDB - hash partitioning, node backup/restore, redistribute utility, splitter
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Your Only Inbox

Unified messaging systems are becoming the control center of an enterprise-wide communications infrastructure.

By Bob Emerson

The foreign exchange division of Dresdner Bank in Frankfurt is automating its process of taking and confirming orders. The bank wants to make trading across different time zones more efficient, so that its traders in New York, for example, could execute an order for Frankfurt after the close of business in Germany. For security as well as reliability reasons, the bank doesn't consider e-mail an option. Consequently, it is installing a network of fax servers in subsidiaries in Frankfurt, London, Singapore, New York, Tokyo, and Hong Kong. This network includes a system of local folders that the bank's traders around the world can skim through when they start work each day, using Microsoft's Exchange client software.

Merck, a large chemical and pharmaceutical company in Darmstadt, Germany, had a problem with customer and supplier support. The firm needs a central checkpoint for incoming customer orders and queries. This checkpoint has to link such diverse systems as Lotus Notes, fax, telex, and SAP's R/3. To solve the problem, Merck is installing a messaging infrastructure that will allow its customer-support staff to send and receive faxes, use an enterprise resource planning system, and check their e-mail with a Web browser.

As these two examples illustrate, both companies created better communication channels by integrating a variety of messages and data into a single inbox. More and more companies are moving in a similar direction.

This concept of unified messaging might sound familiar to users of stand-alone PCs, where you can store voice mail, faxes, and e-mail as well as short messages from pager networks and GSM's Short Message Service into different folders of Microsoft's Exchange client. (For voice mail and short messages you need additional software that plugs into Exchange.)

However, companies usually experience significant difficulties when trying to implement a unified messaging environment on an enterprise level. Tying together data from disparate sources is not an easy task.

One obstacle they face is that legacy messaging applications have evolved from the separate and very different worlds of voice and data. Voice mail and faxes come from the telephony domain, while e-mail started with mainframe computers. Voice mail

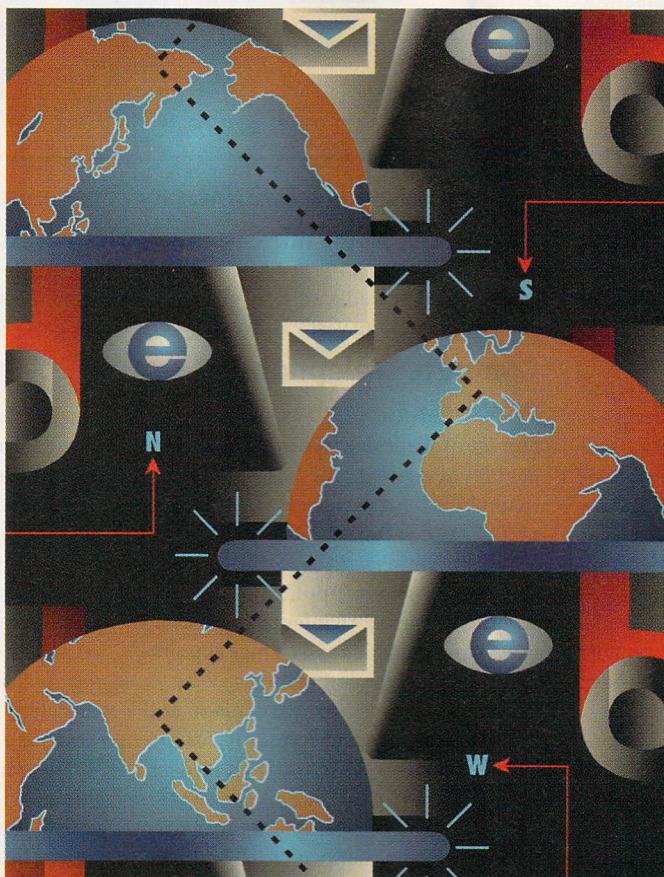
comes in via the corporate private branch exchange (PBX), while e-mail typically arrives on a server. The only thing that these systems share is the ability for individuals to download messages from a central archive.

Faxing makes the picture even more complicated. Faxes bypass the PBX and in many cases go directly to a facsimile machine. Faxes are sent and received over direct lines, and no switching is involved. During the last five years, many corporations have installed computer-based faxing systems that saved them serious money. However, these systems require a virtual direct line such as an ISDN multiple subscriber number or direct-dial numbers; they represent another separate realm in the corporate communications infrastructure.

Many European IT managers are working to integrate these diverse communication worlds. "Integration of e-mail, faxing, and voice mail solves a lot of our communications problems," says Charles Huebler, Merck's information systems administrator.

Integrated vs. Unified Messaging

Some system vendors differentiate between integrated messaging and unified messaging. An integrated solution recognizes that messages do not have to reside on a single server to make them appear in a single inbox. A software gateway between the



different servers creates the unified look and feel (see the figure at right). Unified messaging, on the other hand, refers to an architecture in which Microsoft Exchange Server software hosts third-party fax, voice mail, and other messaging server software and controls the enterprise communication infrastructure. It's an important distinction.

Companies like Lotus and Lucent, for example, that represent the diverse worlds of data and voice messaging, talk of integrated messaging as a software link between voice mail and e-mail servers, but they tend to overlook faxing. Although their approaches build on existing messaging systems and allow users to continue with their familiar messaging interfaces, they do not unify these messages into a single architecture.

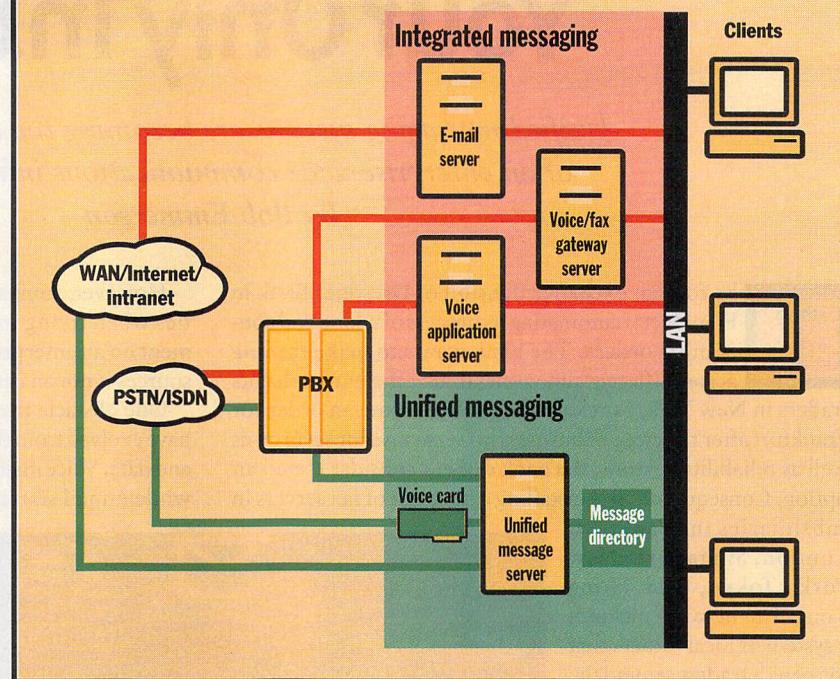
The same is true for communication gateways such as Advox's Omnidate Messaging Server, which is basically a gateway between messaging platforms. Omnidate, for example, translates messages between Novell GroupWise, Microsoft Mail, Microsoft Exchange, fax, and POP3 clients.

Nortel promotes an architecture that enables unification at the client side but keeps message storage distributed. This allows separation of the voice, fax, and e-mail servers and enhances reliability by eliminating a single point of failure; however, IT administrators must continue to manage and control separate systems.

"There is no clear definition of unified messaging," says Shaun Thomson, channel manager with the voice mail company Octel Communications Europe, "but our view is that there should be one directory, one administration system, and one place for all message types." The advantage is that users have only one system for voice, e-mail, and fax, and businesses have much lower administration costs.

Small and medium-size organizations can move toward a unified solution much easier than a large enterprise can because they usually have less fragmented and often simpler messaging environments. For large corporations, the crucial question is whether the convenience of a single in-box and lower administration costs justify the investment in a unified or integrated solution. "In many cases the answer is no," says Larry Fromm, a business development manager with Dialogic. "But if unified messaging is the baseline for sophisticated computer telephony applications that enable new business

Comparing Integrated and Unified Messaging



Unified architecture: Message server hosts fax, voice mail, and e-mail. Integrated infrastructure: Messages don't reside on one server.

models and added-value services, the answer is a definite yes."

Computer Telephony Advances

Storage of all message types in one archive enables almost any messaging scenario that makes business sense. For example, text-to-speech functionality can be used so mobile workers can check all their messages via telephone. Applications are also coming to market that let road warriors listen to their agenda and change appointments using voice commands.

This illustrates how easy it is to add advanced computer telephony (CT) functionality when telephony is an integral part in both the client and the server. Call centers can be implemented on a departmental basis with clearly defined access rights to the messaging server. With unified messaging in place, telecommunications becomes an integral part of mainstream business applications, and it can encompass all media types and virtually all network services.

Unified messaging is also a first step toward Internet telephony and faxing. "Once the move to computer-based faxing and integrated messaging is complete,

then Internet faxing is a viable step," says Richard Russell, managing director of Brooktrout Technology Europe.

The ability to send voice messages as e-mail attachments is a simple but very useful CT application, particularly in large enterprises. Voice Profile for Internet Mail (VPIM) is an extension of two standards: SMTP and Multipurpose Internet Mail Extensions (MIME). VPIM allows users on different voice mail systems to forward voice messages via the Internet. With VPIM-compliant systems, some 100 million existing voice messaging users will be able to exchange voice mail between disparate networks as easily as exchanging e-mail.

This represents a break from the traditional view of voice mail as a PBX application. Instead, with an open architecture, these systems could become a platform for a new generation of applications. With VPIM, instead of having an e-mail address, each user can be found through his or her telephone number. Key players in this area include Centigram, Lucent, Nortel, and Siemens Rolm.

From Faxing to Messaging

"Facsimile machines will not be removed from offices in the near future," says

Group 5 Standard Unites E-Mail and Fax

Where fax and e-mail really differ is in their respective levels of security and reliability. Fax as a point-to-point system is less vulnerable to third-party interference than e-mail transported over the public Internet. On the other hand, e-mail is usually delivered to a password-protected mailbox, whereas at the receiving fax machine, a fax is readable by anyone.

A new standard under development by the Group 5 Messaging Forum will finally tie together the fax and e-mail worlds. "The G5 messaging standard combines the best of both systems and then goes on to add a further level of security and usability," says Chris Oswald, managing director of Equisys and chairman of the G5 marketing committee. Other members of the G5 Forum include Brooktrout Technology, Gammalink, INSO Corporation, Lotus/SoftSwitch, Microsoft, Phillips, Rockwell, Symantec Delrina, U.S. Robotics, and Xerox Corporation.

The G5 Forum was formed in order to develop a new integrated messaging standard that handles any data file by itself or in compound form and is able to cater to future unified messaging needs. The G5 protocol has been designed to seamlessly integrate with Group 3 fax, Internet e-mail, and LAN e-mail. This means that in order to send a message to multiple recipients using any mix of Group 3 fax, Internet e-mail, and full G5 messaging, the user will not need to specify the transport service in use by the recipient.

For messages transferred between G5 systems, the recipient automatically sends back a confirmation (postmark) containing the receive time, message identification, and authentication codes. The original and confirmation postmarks can be stored at the points of transmission and receipt, providing mutual nonrepudiation of the message and its contents. G5 messaging also includes automatic archiving of both

inbound and outbound messages together with transmission details.

The G5 messaging specification is based on Multipurpose Internet Mail Extensions (MIME). The standard provides for transmission and identification of any file type that's registered with the Internet MIME registry, Internet Assigned Numbers Authority (IANA). The G5 message header, for example, is a new MIME file type.

G5 Messaging is designed to operate over a variety of underlying data transport mechanisms in a fashion that is independent of the particular transport used. Supported transport protocols include V.34, T.30, and T.434. Other transport mechanisms such as ISDN or wireless networks might be employed in the future. In addition, the G5 service integrates with an X.500 distributed directory service using an access protocol that is based on the Lightweight Directory Access Protocol (LDAP).

address books receive templates to support the fax address type. Exchange then employs its synchronization features in order to extend these capabilities to other Exchange servers on the network as well as to all the Exchange clients.

Note that although Exchange on the client side is a messaging application, and can be used as such on a stand-alone PC, Exchange Server is basically a database engine that facilitates mailbox administration. Traditional client/server fax products have a dedicated server with the equivalent store, transport, and user directory and client transport services of Exchange Server. The system and directory are usually administered through a dedicated fax administrator program, and dedicated faxing software is also required on the client side. Thus, without something like Faxination's close integration to the Exchange environment, the obvious drawback of these systems is a 100 percent redundancy, on both the client and the server.

Faxination also integrates with SAP's R/3 business application. This way, when direct inbound routing is used, Faxination delivers incoming faxes to the desktop within the SAP Office environment. In addition, Faxination supports telex and Short Message Service (SMS), enabling messages to be sent from a PC to a mobile phone or pager.

COM:ON's C3 Messenger platform interoperates with Microsoft Mail, Microsoft Exchange, and Novell GroupWise. With Lotus Notes, it automatically routes incoming faxes to the Notes Server and informs the user about incoming messages by way of SMS or a pager.

The data route toward unified messaging adds a fax interface to client-oriented e-mail products. Tobit Software comes from the opposite direction. Its strategy is based on the assumption that most companies use fax as the first communications medium and that the market requirement is for an extension of this environment at a later date. The company therefore developed a fax server product that can evolve into a universal messaging server. This universal messaging server allows organizations to set up an asynchronous, store-and-forward communications environment that incorporates all major media types.

Tobit's David is a communications operating system that manages and controls a multimedia database including faxes, e-mail, voice files, and any other kinds of

Martin Hannah, CEO of Topcall International. "On the contrary, faxing is a growth industry."

As a result, there is a wide choice of robust client/server faxing programs from vendors with the proven ability to develop and support customized solutions. These solutions now integrate with enterprise messaging platforms.

Zetafax, from Equisys, is a client/server fax system that has been on the market for five years. It now includes an e-mail gateway that integrates with Microsoft Exchange, Microsoft Mail, Lotus cc:Mail, Lotus Notes, and Novell GroupWise. "There is a trend toward mail-enabling faxing programs," comments Chris Oswald, managing director of Equisys. "More and more people are using e-mail with attachments, but some recipients may be reachable only by fax, and mobile workers may want their faxes to be delivered with their e-mail messages. In both

cases, let the software worry about how the message gets delivered."

Fenestrae's Faxination fax server product integrates in a similar way with Microsoft Exchange. However, in contrast to Equisys' Zetafax, you can use the Exchange client software and don't need to install an extra client. The big advantage is lower administration cost because there is no need to install additional software on users' workstations. All the faxing functionality needed to make the Exchange client fax-capable is automatically downloaded and added to the Exchange client when the program installs on the server.

Faxination enables a fax message to be used on the server side so that Exchange Server can automatically use the Faxination services as the default fax transport medium. It extends the Exchange directory with additional fields, which contain the fax related user properties, and the

documents. It stores all items regardless of format in the same hierarchical archive, which can be used for internal communications as well as for customers' projects. Users can access the information in the David database via LAN, phone, fax-on-demand, or Web browser. It is basically a universal messaging server.

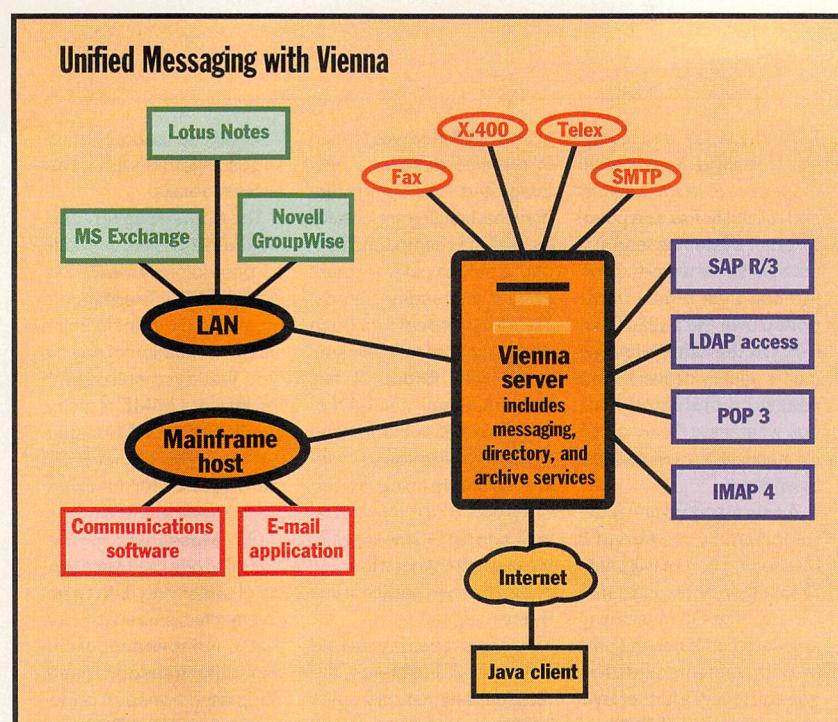
David comprises several 32-bit multitasking and multithreading modules that run as NetWare loadable modules. The architecture includes a service layer; a transport layer, which handles hardware-specific addressing; and the front-end layer, which enables client access to the LAN. An NT version will be available by the end of this year, the company says.

Messaging Backbone

Like Merck and the Dresdner Bank, many large enterprises have a complex mix of computing and messaging environments. They might be using Microsoft Exchange, Lotus Notes, SAP R/3, Novell GroupWise, and Hewlett-Packard OpenMail, and they might require connectivity to DEC Mailbus as well as to IBM mainframes and AS/400 systems.

Topcall, for example, addresses these complex environments with its latest enterprise messaging solution, Vienna. At the heart of Vienna is a message server, which links a variety of clients to a heterogeneous environment (see the figure above). This approach incorporates the message queue, the mailbox system, and a directory that is compliant with the Lightweight Directory Access Protocol (LDAP). A so-called line server interfaces with fax, telex, and X.400, as well as AS/400 systems, mainframes, and LANs.

Vienna links the message server to communications services such as e-mail (POP3,



High-end systems such as Topcall's Vienna establish a unified enterprise-wide communications backbone.

IMAP4) or the Web and to application platforms such as SAP's R/3, SMTP, Microsoft Exchange, and Lotus Notes. It converts message attachments into one or multiple document formats in order to ensure that the recipients can read and process the message content immediately. Vienna also includes an archive server, which can index and archive the entire communications flow. Completing the range of supported access platforms, Vienna also provides a Java-based messaging client.

Open access to LDAP means that virtually any client can use the address services

of the system's directory. Using the synchronization function, Vienna can address user directories from messaging platforms such as Notes and Exchange and make them available to all users. In this way companies can derive the benefits of having a single, integrated address book without having to travel down the X.500 directory services road.

Unified messaging as a concept has been around for some time. But the data world has concentrated on e-mail and tended to ignore the traditional telephony-based messaging systems (faxing and voice mail). There is now a big push from users to tie together both worlds.

It will not happen overnight, however. For most large corporations, it will be an expensive and technologically challenging endeavor to embed all communication activities in a unified environment. Potential pitfalls are numerous, especially if working practices and the communication infrastructure are not in sync. But the rewards gained from establishing a unified messaging system far outweigh the initial installation pain. ■

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Next-Generation Notebooks

Mobile PCs sport new processors, longer battery life, increased storage, and better graphics.

By Stella Kao

In the past year, an increasing number of corporations began issuing their employees high-end notebooks as replacements for their desktop PCs. The trend will continue as Intel attempts to use the most advanced technologies in mobile chips, which will boast most of the features that road warriors require in a system.

The latest buzzword is Tillamook, the code name for the Pentium multimedia extensions (MMX) microprocessor for notebooks. Whereas the P55C mobile chip reaches only 166 MHz, Tillamook advances clock speeds for mobile computers to 200 and 233 MHz. Early next year, Intel will release a 266-MHz version of the chip.

More important, this latest mobile processor keeps power consumption and heat to a minimum. Tillamook, which is manufactured on a 0.25-micron-process technology, allows for a core voltage of 1.8 V, which keeps power dissipation below 6 W. The 2.45-V P55C dissipates closer to 8 or 9 W.

This is the first time that Intel has targeted a mobile chip as a lead product for a new technology generation. Tillamook is scheduled to ship in the standard TCP packaging of existing Pentiums and with Intel's Mobile Module (MMO) format, a module on which the processor, L2 cache memory, and some controller chips will be mounted.

The MMO is designed to help OEMs upgrade their notebooks with faster Pentium-level chips, according to Intel. For example, next year, they could upgrade a system with Tillamook to the Pentium II, dubbed Deschutes. The introduction also reflects a move by Intel to standardize more notebook components, which in turn will keep prices down.

It took Taiwanese notebook makers a long time to accept the MMO. The companies were afraid that the module connector might raise reliability and stability issues. Besides, greater flexibility for the processor can mean less flexibility for the system. Some vendors are concerned that Intel's approach will lock them into Intel's camp and relatively reduce the value of their products. The MMO, of course, doesn't support processors from AMD, Cyrix, Digital Semiconductor, and other companies.

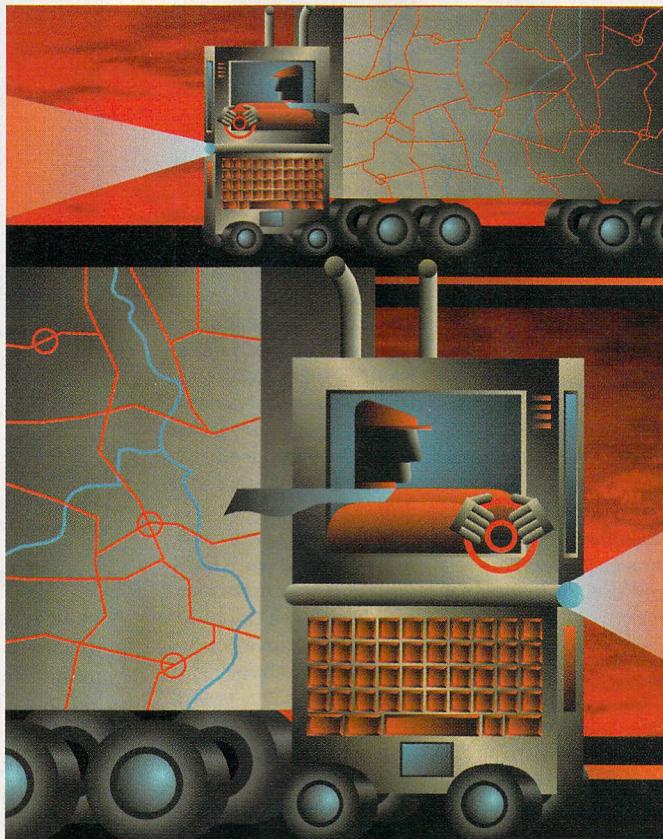
Acer is one of the first companies to implement the MMO on its latest generation of notebooks. With the new architecture, users with little technical know-how will for the first time be able to replace the notebook CPU, says Brian Chong, director of the mobile system business unit at Acer. Moreover, users will be able to upgrade to forthcoming generations of processors.

The price of the 233-MHz Tillamook processor is expected to be around \$520 by the end of the year, while the 266-MHz version will be about \$650. By November, when Intel drops its processor prices, the current 166-MHz mobile Pentium MMX is expected to fall from about \$480 to \$375.

Several notebook heavyweights have introduced Tillamook-powered notebooks on the heels of Intel's release. IBM has released the

ThinkPad 770, a high-end notebook with the new chip. Toshiba has announced a new Tecra portable with a 233-MHz Tillamook. Digital and Compaq have exhibited similar models that are priced starting at about \$4000.

In Taiwan, notebook makers looking to meet OEM customers' needs have lined up to support the new technology. A host of them—including Acer, Asustek Computer, Chunex Electronic,



More Mobile-Chip Options

Every now and then, notebook manufacturers decide to take a chance on non-Intel processors. In today's Windows market, that means one of two chips: AMD's K6 family or Cyrix's MediaGX. AMD and Cyrix are expected to announce their mobile processors by the end of the year. Industry analysts anticipate that the decreasing entry-level prices on desktop PCs will soon be found on portable machines, meaning that end users will have more options for low-cost units.

AMD is expected to start sampling a low-voltage 266-MHz version of the K6 that could mark its reentry into the portable market. The next-generation 300-MHz K6 is the first processor that the company has designed and built using 0.25-micron-process technology, much like the 200- and 233-MHz Tillamook chips that Intel unveiled in September.

The AMD chip will ship in both pin-grid array (PGA) and ball-grid array (BGA) packaging. The former will target the existing Socket 7 market. The BGA-based mobile K6 will aim at a niche market for small form factors. AMD is trying to convince the top 10 OEMs to jump on the K6 bandwagon. A few notebook manufacturers in Taiwan have tested AMD's mobile K6 chip and found its performance impressive.

Clevo demonstrated an entry-level notebook that supports both Intel's Mobile Module (MMO) and Socket 7 architectures at the fall Comdex. It sells for \$1300 to \$1500, depending on features. Another maker, which asked not to be named, says it plans to introduce K6-based notebooks, starting at a price range from \$2000 to \$2500.

Some Taiwanese companies are reluctant to use the AMD technology. Acer

stresses that it will not use any Intel alternatives before the end of the first quarter in 1998. However, it has been testing the mobile K6 in its notebook series for some time. In spite of the fact that the mobile K6 achieves remarkable performance and heat dissipation, Acer's Brian Chong says, "AMD's biggest problem is convincing OEMs that it is worthwhile using an AMD device as opposed to staying with Intel. It is important for us to know if they are going to have second- and third-generation products."

At the low end, Cyrix, which has been acquired by National Semiconductor, is getting a lot of attention for its MediaGX chips. The company's 0.35-micron MediaGX and MediaGXm mobile chips integrate CPUs, core logic, VGA graphics, and 16-bit stereo sound in a two-chip solution with a starting price below \$100. The new MediaGXm supports multimedia extensions (MMX) and synchronous DRAM (SDRAM), and it includes a 16-KB instruction and data cache.

In addition to 166- and 180-MHz versions, Cyrix is expected to unveil an MMX-enhanced MediaGX processor running at 233 MHz, with a power consumption that may be as low as 5 W before year's end, according to a Cyrix executive for Asia-Pacific.

Taiwanese makers are less worried about using Intel alternatives for the entry-level segment, because Intel is not really addressing that end of the market. By using the MediaGX solution, portable makers could bring notebook prices closer to \$1500 than today's low end of \$2000, Cyrix officials claim.

On the high end, Digital Semiconductor is working on a mobile Alpha chip running at speeds well over 400

MHz. This is slated for introduction early next year. In a race to steal thunder from Intel, a Digital official said that the mobile Alpha chip could run at clock speeds as high as 533 MHz by the second quarter of next year, when Intel's forthcoming mobile Deschutes version of the Pentium II is scheduled to reach 300 MHz.

Portable vendors in Taiwan are skeptical of Alpha's performance on an x86 platform. While native Alpha NT Office is still nowhere to be seen, it takes a special software-conversion technology, the Digital FX!32, to let Alpha systems run 32-bit x86 Windows and NT applications as fast as they run on comparable x86 systems.

And even if Digital could overcome that hurdle, Acer's Chong notes that it is questionable if Digital could price Alpha mobile chips sufficiently low. "The perception is that the price for a non-Intel notebook must be low," he says.

Another high-performance mobile solution is the PA-RISC laptop. In October, RDI, a professional workstation-class portable vendor in the U.S., introduced two Unix-based models priced at \$12,000.

RDI's Precisionbook, comparable to an HP-UX Visualize B-class workstation, is powered by a 132- or 160-MHz SPARC processor. Another version, which runs at 167 or 200 MHz, is also available. Both models incorporate 14.1-inch screens.

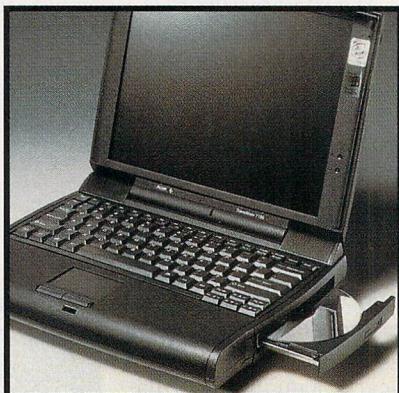
RDI claims that these units are priced only 30 percent to 50 percent higher than comparable workstations, making these notebooks truly competitive with HP's and Sun's desktop equivalents. Wintel notebooks usually sell for 100 percent more than their equivalent PCs.

Clevo, Compal Electronics, First International Computer, Mitac International, Twinhead International, Umax Data Systems, and more—showed products designed to run Tillamook and MMX technology.

Acer rolled out the TravelMate 7100, a notebook that supports Intel's 233-MHz Tillamook. It comes with a 12.1- or 13.3-inch active-matrix screen and includes 32 MB of synchronous DRAM (SDRAM), a 2-GB hard drive, and a 128-bit graphics accelerator with 2 MB of video memory.

Both Mitac and Clevo have exhibited a Tillamook-based notebook. Mitac's 6031 sports a powerful 233-MHz Pentium processor and a brilliant 14.1-inch active-matrix display.

The leading notebook from Clevo is the Model 66, which in its latest version has an MMX-compliant Tillamook 200- or



Acer TravelMate 7100

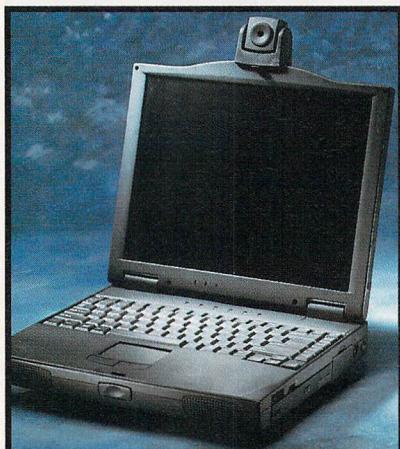
233-MHz CPU. Eventually, this machine may come with a 14.1-inch LCD, but for now, it comes with a 12.1- or 13.3-inch screen. The Clevo 66 also has a Zoomed Video (ZV) port and fast infrared (IR).

Pentium II

In the first quarter of next year, Intel will extend its notebook module strategy to mobile Pentium II processors with 233- and 266-MHz clock speeds. Deschutes is the first version of the Pentium II geared for notebooks. Intel has been promising that the transition from Pentium MMX to Pentium II will be relatively easy, because the new module will also be able to accommodate the first generation of mobile Pentium II processors. However, many notebook manufacturers are skeptical, because they face formidable power and heat problems with Pentium II designs.

Notebook makers say that the modules the chip will come packed in won't fit into

their latest ultrathin computers. It will be available for notebooks in the 2.75-by-4-inch MMO, on which Intel delivers its 200-MHz Tillamook chips, and in a mobile derivative of Intel's single-edge cartridge



Mitac 6031

used for desktop Pentium IIs.

Beyond the packaging issues, many Taiwan-based notebook makers said that Deschutes will raise power and thermal issues in their designs. The new designs

Makers Wrestle with Hot Air

Wondering why your portable is unusually hot? So hot that you can barely put your hand on it? There are many contributing factors. One likelihood is that your notebook uses a desktop processor.

At the Computex show that took place in June in Taipei, Taiwan, a few vendors displayed 200- and 233-MHz portables. At the time, however, the fastest mobile processor from Intel was the 166-MHz Pentium multimedia extensions (MMX). Trying to propel their top-of-the-line, feature-rich notebooks ahead of the crowd, these companies used desktop CPUs in the notebooks.

One notebook maker, which didn't want to be named, said: "We are doing

it because the desktop chips are so much cheaper."

However, these powerful processors consume a great deal of power and give off a lot of heat. This results in a host of problems, such as shorter component life and unstable board design.

"Most components can hardly sustain such a high operating temperature," says Brian Chong, director of the mobile system business unit at Acer.

Unfortunately, the introduction of high-power chips is expected to lead to a new round of the heat problems. "Excessive heat will become particularly pressing as Intel brings the P6 architecture to notebooks by mid-1998," says Frank Tso, director of the PC and workstation group

at Umax Data Systems.

Intel's current task with the mobile version of Deschutes is to limit the chip to 8 W while running at speeds of 233 and 266 MHz. Currently, the chip uses 12 W.

Seeking to address the looming heat-dissipation problem, vendors have developed many innovations in terms of thermal management. Some vendors say they will have to use fans and sophisticated cooling mechanisms to further cool the systems.

Most Taiwanese notebook makers are looking at a forthcoming crop of heat sinks, heat pipes, heat plates, and fans that may be on the top, bottom, and sides of the casing to keep the Deschutes notebooks cool.

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will centralize the heat in one place in the notebook. The first Taiwanese company that obtained a Deschutes sample from Intel has conducted full tests on the system upgrade. It says that the result is not as bad as makers were speculating. The manufacturer, which asked not to



Clevo Model 66

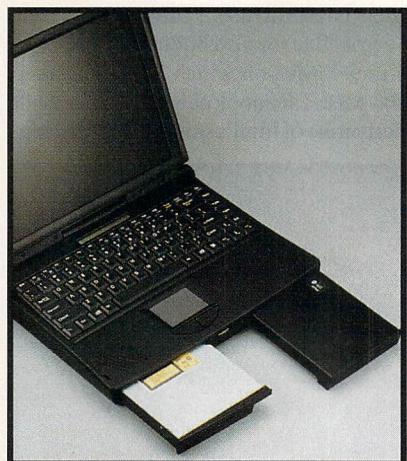
be named, points out that the new design provides an easy upgrade path that will allow end users to enjoy fresh technology as soon as it arrives.

Longer Battery Life

For a few companies, battery life is a major selling point. Acer, for instance, boasted the longest battery life on its TravelMate 7100 using Intel's latest 233-MHz Pentium processor. The product, which is powered by a single lithium-ion battery pack, clocked an impressive time between 8 to over 10 hours, according to Acer.

Intel will release power guidelines for OEMs, hardware component makers, and OS and application vendors. Using Intel's Power Monitor—a tool that measures power levels during the software-development process—Independent software vendors (ISVs) can write software specifically for the mobile market. Others say that they can achieve longer battery time by adding hot-swappable battery packs. Of course, the trade-off is the extra weight.

Currently, mainstream models costing between \$2000 and \$3000 come with either 11.3- or 12.1-inch screens. But ven-



Asus P630

dors predict that LCD panels with sizes smaller than 12 inches will be obsolete in 1998, as the cost of large-size LCDs keeps falling dramatically. At present, the difference between a 14-inch screen and a 12-inch screen is \$1000.

However, even though the larger LCDs let users work at 1024- by 768-pixel resolution without eyestrain, they consume a lot of power. Alan Su, product manager

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at Clevo, says, "Large screens probably constitute less than 3 percent of the market at the moment."

Nevertheless, K. C. Chang, product manager at Mitac, points out that the so-called meganote machines, with LCD sizes from 14 to 15 inches, are exceptionally popular in the Japanese market. Mitac introduced the world's first 14.1-inch thin-film transistor (TFT) LCD-equipped model early this year. "Many corporations in Japan have started to use portables as desktop PCs," Chang says, "because they lack desktop space."

More notebooks are being used for multimedia presentations. As a result, cutting-edge notebooks are available with up to a 3-GB hard drive. In addition, many companies have included LS-120 floppy drives as a replacement for existing 3½-inch floppy drives in notebooks.

The LS-120 provides 120 MB of storage at five times the speed of a standard 1.44-MB drive but can still read and write 1.44-MB formatted data on the older disks. Some say they expect the market for LS-120 floppy drives to grow considerably during the second half of next year.

DVD and Videoconferencing

Major Japanese firms, including Matsushita Electric, Panasonic, and Toshiba, announced their first DVD-ROM (Digital Versatile Disc) drives for use in notebooks.

In addition to reading DVD-ROM discs, Matsushita's SR-8183 can also read CDs (at 20x speed), CD Recordable (CD-R) discs, and CD Rewritable (CD-RW) discs. With the fast CD-ROM reading, Matsushita claims the new drive is also the fastest such unit available for notebooks.

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Toshiba's unit features CD-ROM reading at 16× speed, slower than the Matsushita unit, but reads DVD-ROM discs at double speed. Panasonic's MKE drive reads DVD-



Acer's optional FastBack second hard drive provides easy backups

ROM discs at 1.5× speed. Most major makers will release DVD-enabled notebooks to keep up with the competition.

Thanks to the increasingly powerful platforms and finalized H.324 interoperability standard, the mobile computer is rapidly emerging as an important video-

conferencing platform. Many notebook vendors plan to roll out videoconferencing-ready models in 1998. Acer, Clevo, and Mitac will introduce videoconferencing kits as an option next year. Standard packages will include a 56-Kbps modem, a charge-coupled device (CCD) camera module, a video-capture card, and software.

The latest advances in telecommunications and image-sensor technologies have enabled hardware makers to bring out a solid array of videoconferencing solutions that offer up to 15 frames per second of live video. Says Su: "Videoconferencing will become standard on notebooks."

What more can we expect in the next few years? Definitely look for the Accelerated Graphics Port (AGP) and possibly networking. All companies in Taiwan claim they have AGP-ready models on the drawing board. Some systems will even come with networking devices. **B**

Stella Kao is a BYTE contributing editor in Taipei. You can reach her by sending e-mail to meou@email.gcn.net.tw.

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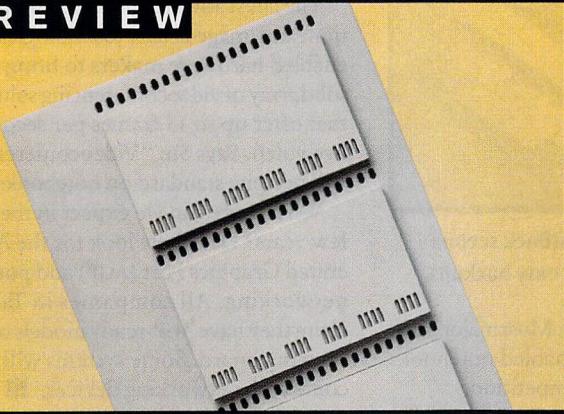
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CDserve Nexus Class works independently of any network file servers, lets a maximum of 255 concurrent users access up to 150 CD- or DVD-ROMs, and enables multimedia information to be retrieved across a LAN at speeds of up to 10 times faster than state-of-the-art CD-ROM towers.

Although CD-ROM drives' transfer rates have steadily increased, these speed improvements are of little benefit in shared-access applications. The reason is that access times of today's CD-ROM drives in the range of about 150 ms slow down concurrent use. CDserve avoids this drawback by storing and compressing an image of each CD-ROM on high-capacity Ultra-SCSI hard drives. In addition, CDserve's Direct Network Attach architecture uses your LAN's bandwidth more efficiently than file-server-based systems. When a network user requests access to the device, it decompresses data on the fly and transfers it at an average transfer rate of about 6 MBps—*independently* of the number of concurrent users.

You can install CDserve Nexus Class devices in a network without a conventional network file server. All you need on the workstations are a network card and a protocol stack that includes an IPX, TCP/IP, or NetBIOS interface and an additional CDserve CD-ROM driver. The systems work with all versions of Novell NetWare, Windows 95, LAN Manager, Lantastic, and Windows NT NOSes.

The high-end CDserve Nexus Class series supports storage capacities of up to 90 GB. If you don't need the high capacities, DVD support, and performance of Ultra-SCSI and PCI technology, you can get a less expensive CDserve 10 system.

—Rainer Mauth

Printer

Portable Thermal Printer

DESIGNED TO BE INTEGRATED INTO OFFICE and industrial environments, Investix's DX 112 thermal printer can print 80 columns on 112-mm-wide paper. If you have a need for double prints, the Windows-compatible machine prints two re-



ceipts side by side on 55-mm-wide paper. The DX 112 printer emulates Epson and IBM printers and connects to several devices via RS-232 interfaces.

Price: \$249.
*Investix SA, Paris, France,
+33 1 44 63 57 57;
fax: +33 1 44 63 57 50;
http://www.investix.com.*
Enter 1026 on Inquiry Card.

Networking

VPN System Secures WANs and Intranets

With clPRO, a VPN COMMUNICATIONS system, you can protect multisite networks without the restrictions of traditional security applications. It uses hardware-based security gateways and fits into existing networks without system changes. It uses IP as the communications protocol and provides for data-transmission speeds of up to 100 Mbps.

Price: Starts at \$6950.

*Radguard, Tel Aviv, Israel,
+972 3 645 5489;
fax: +972 3 648 0859.
Enter 1057 on Inquiry Card.*

Displays

Use a Large Screen for Videoconferences

THE DAVIS POWERSCREEN, A 1.5- BY 1.8-meter LCD built on TI's Light Processing Technology, includes a Pentium PC module that connects to VCRs, surround-sound speakers, and the Internet. You can also use it to watch TV and satellite programs and conduct videoconferences via ISDN. Additionally, the Picture-in-Picture feature offers simultaneous display of different sources. Via a cordless mouse and keyboard, you can use the Powerscreen as a standard PC.

Price: DM 28,000.
*Davis, Drammen, Norway,
+47 3220 9000;
fax: +47 3220 9001;
http://www.davis.no.*
Enter 1024 on Inquiry Card.

Bright 42-inch Plasma Screen

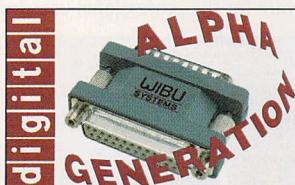
PLASMAVISION 42, A 42-INCH-DIAGONAL flat-panel display, is easily viewable in any ambient-light condition through a viewing angle of 160 degrees. You can mount it on a wall. It supports the 16-to-9 wide-aspect-viewing format. With over 400 ANSI lumen brightness, SVGA resolution, and a palette of 16.7 million colors, it creates bright and detailed images.

Price: £9875.
*Steljes, Ltd., Brentford, U.K.,
+44 181 213 2100;
fax: +44 181 213 2121;
http://www.steljes.co.uk.*
Enter 1053 on Inquiry Card.

Security

Wibu-Key Supports Digital Alpha

THE SOFTWARE COPY-PROTECTION SYSTEM Wibu-Key now supports Windows NT on Digital Alpha PCs. It comes as a series of DLL and CPL modules, and includes a server version that allows the protection of an entire network with just one dongle. The system also works with the Intel 32-bit emulator FXI32. The next ver-



sion will be available as an Alpha-compatible driver installation kit.

Price: Call company.

Wibu Systems, Karlsruhe, Germany, +49 721 931720; fax: +49 721 9317222.

Enter 1058 on Inquiry Card.

Communications

Four Serial Ports for the Mac

THE QUADRIGA/S PCI CARD FOR POWER Macs offers four high-speed serial ports that you can individually configure. You can transfer data with up to 230 KBps per port and configure transfer rates separately on each port. The package includes a software tool that allows you to monitor each port's status. For the administration of the board, you have to use Apple's Communication Toolbox.

Price: DM 695.

Hermstedt, London, U.K., +44 171 242 4060;

fax: +44 171 242 2904; <http://www.hermstedt.com>. Enter 1025 on Inquiry Card.

ADSL and Phone on a Single Line

WITH ORCKIT'S ORVISION ADSL MODEM, you can access an ADSL service and simultaneously make two phone calls over a single pair of copper wires. This is possible because the device transmits both ADSL and DAML signals concurrently. It further lets you transfer several megabits of data per second over one regular phone line without interfering with the phone signals.

Price: Call company. Orckit, Tel Aviv, Israel, +972 3 696 2121; fax: +972 3 696 5678; <http://www.orckit.com>. Enter 1028 on Inquiry Card.

New 56-Kbps Modems in a PC Card

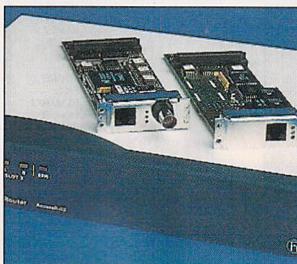
INTERTEX'S PC CARD MODEMS OFFER 56-Kbps high-speed Internet access. Special features include automatic adaptation of modem speed to changing line conditions and a sleep mode to save energy. A high-end version provides additional voice functionality, a flash EPROM, and additional low-power-consumption components.

Price: From £176. Intertex Data Systems, Ltd., London, U.K., +44 181 870 6924; fax: +44 181 874 4788; <http://www.intertex.co.uk>. Enter 1054 on Inquiry Card.

AccessR-03 Connects LAN to WAN

SUPPORTING TCP/IP, IPX, PPP, Multilink PPP, RIP, X.75, and HDLC pro-

tocols, AccessR-03 enables you to connect a LAN to the Internet via up to 30 ISDN B-channels. The access router also includes authentication via PAP and CHAP as well as identification of inbound calls and call-back functions. In



addition, the device supports V.42bis compression and remote configuration.

Price: Starts at DM 5070. Hirschmann, Neckartenzlingen, Germany, +49 7127 140; fax: +49 7127 141 214; <http://www.hirschmann.de>. Enter 1029 on Inquiry Card.

Systems

High-End PCs

THE SCENIC PRO D6 AND M6 PCs COME with 233- or 266-MHz Pentium II chips, a 512-KB L2 cache, Intel's 440LX chip set, and an on-board monitoring system with enhanced security functions. You can choose between IDE and Ultra Wide SCSI hard drives and two Matrox 3-D graphics boards. The system includes a 120-MB floppy drive and can receive faxes or transmit data in sleep mode via an Advanced Configuration and Power Interface.

Price: Starts at DM 3799.

Siemens Nixdorf, Munich, Germany, +49 821 804 3680; fax: +49 821 804 3600.

Enter 1022 on Inquiry Card.

Turn C++ applications into Java code, and access LAN-based CD-ROMs faster.

Multiprocessor Internet Server

PERICOM'S QUATTRO INTERNET SERVER allows multiprocessing under Windows NT and Unix with up to four 180-MHz Pentium Pro CPUs. The Quattro provides slots for 12 hot-swappable SCSI hard drives and four peripherals. The built-in management circuitry monitors all hardware components for signs of trouble and reports the system status back to the software. The server includes a number of security features, including mechanical lock loop.

Price: £2499. Pericom Desktop Networks, Milton Keynes, U.K., +44 1908 265533; fax: +44 1908 265534; <http://www.pericom.co.uk/networks/>. Enter 1023 on Inquiry Card.

Multiprocessor System

Multimedia Servers Interconnect via ATM

WITH THE ANTARA REAL-TIME SERVERS, YOU can distribute large amounts of multimedia data efficiently over a broadband network. The systems, which include parallel 200-MHz PowerPC chips or parallel 200-MHz Pentium Pro processors, interconnect via 25- to 622-Mbps ATM networks. They also have powerful multimedia search-and-retrieve software. The microkernel is compatible with Unix, Chorus, and Windows NT.

Price: Call company. CS Technologies Informatiques, Paris, France, +33 1 53 67 21 88; fax: +33 1 53 69 21 53; <http://www.csti.fr>. Enter 1055 on Inquiry Card.

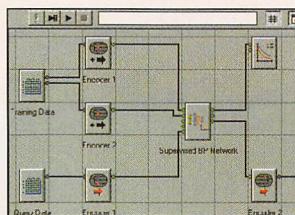
continued

SOFTWARE Development

Easy-to-Understand Neural Networks

THE NEUFRAME NEURAL-NETWORK DEVELOPMENT TOOLKIT now comes with a

Rule-Fire Matrix facility that lets you understand a neural network's decision-making process and enhance the quality of embedded solutions. It also includes radial basis functions and the ability to input graphical image data directly into a network. The professional version of NEUFRAME also supports the Windows



OLE automation interface for document embedding.

Price: Starts at £350.

Neural Computer Sciences,

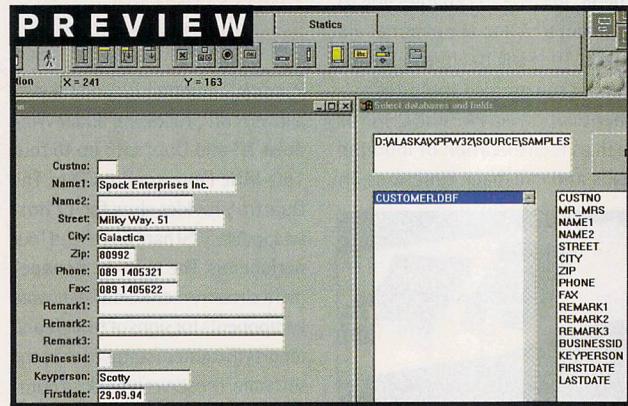
Totton, U.K.,

+44 1703 667775;

fax: +44 1703 663730;

<http://www.ncs.co.uk>.

Enter 1033 on Inquiry Card.



Xbase++

Price: DM 699 for the EEP version; DM 799 for the final version

Enter 1030 on Inquiry Card.

Alaska Software

Eschborn, Germany
+49 6196 95720
fax: +49 6196 957222
100436.1375@compuserve.com

Xbase++ Translates Clipper Applications to 32-bit Windows

Although Windows is clearly the way the world is going these days, DOS is not dead yet. Many large companies have critical DOS database applications that were written in Xbase-compatible programming languages such as CA-Clipper. Xbase++ for Windows 95/NT opens a way for these applications to move to the 32-bit world.

Xbase++ is, apart from some functions and aliases that are not available, compatible with Clipper 5.2. Recompilation of existing Clipper source code with Xbase++ will translate your code into a running 32-bit application. In addition, Xbase++ lets you design a GUI that makes your program look like a native Windows 95 or NT application. It also provides an excellent means to further enhance code using object-oriented features such as multiple inheritance.

The Early Experience Program (EEP) I tested comes with the Xbase compiler, Microsoft's help compiler, a debugger running in character mode, a GUI builder, database engines, several sample programs, and programming libraries for static and dynamic binding. For developers who want to get a feeling of the product's power, the EEP version makes a lot of sense.

However, this version includes several bugs in the GUI builder and emulator. Some GUI elements either don't look like Windows controls or don't work properly. Additionally, the GUI emulation process of the EEP version is slow.

Despite these problems, Alaska Software has developed a sophisticated tool that is easy to use and even supports multithreading. Expect the final version of Xbase++ to be released by the end of the year.

—Bernhard Steppan

provides optimized data-exchange functionality. Additionally, it lets you create comprehensive documentation of your design and synchronize 2-D and 3-D views to increase development speed.

Price: Starts at DM 7400.

Ziegler-Informatics,
Mönchengladbach, Germany,
+49 216 695 556;

fax: +49 216 695 5600;

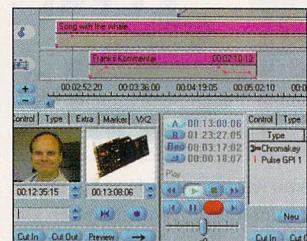
<http://www.caddy.de>.

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Multimedia

Professional Video-Editing Suite

CONTROLLING INPUT DEVICES AND RECORDERS via FireWire, RS-232, and RS-422 interfaces, Assembly Line eXtra (ALX) is video-editing software for the professional user. In



Convert C++ Applications into Java

IF YOU WANT TO CONVERT YOUR C/C++ applications into Java without reprogramming, Elements Converter/J may help you. It works particularly well with graphical interfaces that are to be published on the Internet. The software supports the development of Java clients for existing client/server applications as well as concurrent development in Java and C/C++.

Price: Call company.

Neuron Data,
Neu-Isenburg, Germany,
+49 610 273 70;

fax: +49 610 273 7199;

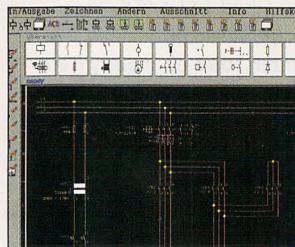
<http://www.neurondata.com>.

Enter 1032 on Inquiry Card.

Engineering

CADDY Makes Design Easier

THE CADDY 14.0 ELECTRONIC DESIGN module now includes Windows NT compatibility and increased graphics performance. It also makes handling of design elements easier and



addition to the common insert and assemble editing techniques, it lets you mark scenes that you want to revise and cache them on a hard disk. When your clip is completely edited, the software automatically combines the original scenes with the material stored on the hard disk.

Price: Starts at DM 598.

COMO: Computer & Motion,
Raisdorf, Germany,
+49 430 783 580;

fax: +49 430 783 5899;

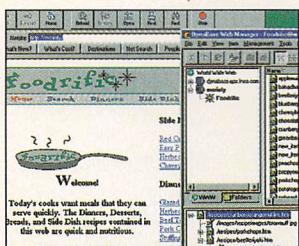
<http://www.como.com>.

Enter 1039 on Inquiry Card.

Web

Better Web Publishing

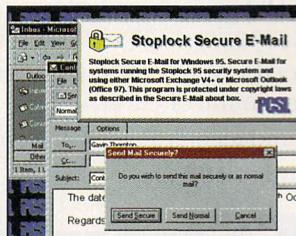
THE WEB PUBLISHING TOOL DYNABASE NOW offers enhanced performance and dynamic-publishing features. It includes a multithreaded client with a simple user interface that helps to



Contact: Webplanet, Grasbrunn, Germany, +49 89 46 200 98 30; fax: +49 89 46 200 98 420; <http://www.webplanet.de/>. Enter 1060 on Inquiry Card.

Secure Your E-Mail

STOPLOCK SECURE E-MAIL is a SECURITY extension for Microsoft Exchange that directly integrates with the menu of Exchange 4.0. The pack-



age offers transparent decryption for all authorized users. Network managers can administrate the security setup of Stockplot Secure E-Mail remotely.

Price: £60.

PCSL, Marlow, U.K., +44 1628 890390; fax: +44 1628 890116; <http://www.pcs.com>.

Enter 1061 on Inquiry Card.

Security

Black Box Monitors Computer Activities

LIKE THE BLACK BOX IN AIRPLANES, THE DIGITAL SCREEN ARCHIVER (DSA25) records a computer's activities over a period of several years. It takes and archives screen shots of the current activities in regular time intervals. Its 25-to-1 compression algorithm allows up to two years of activity to fit onto one magneto-optical disc. Therefore, you can trace any transaction back to its origin, and formerly undetected access to a computer may be revealed by the DSA25 archive.

Price: Call company.

DB Research, Bootle, U.K., +44 151 944 1448; fax: +44 151 944 1418; <http://www.dbresearch.co.uk>. Enter 1034 on Inquiry Card.

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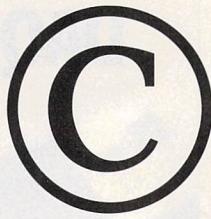
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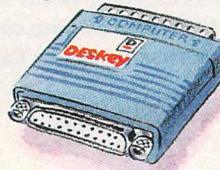
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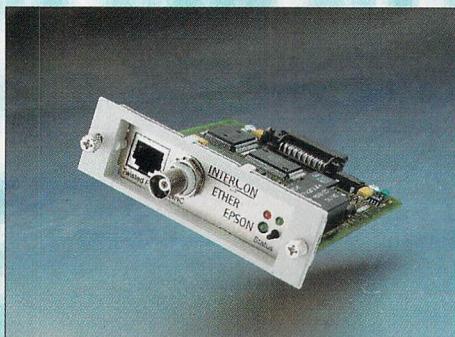
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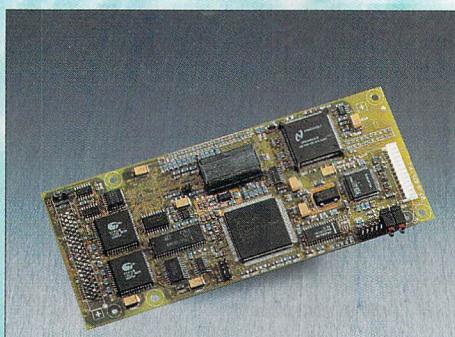
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Fax: +49 / 521 / 94226-99
Internet: <http://www.seh.de>
E-Mail: info@seh.de
Compuserve-Id: 100742,1452

Software Support

- Novell 4.x NetWare Directory Services (NDS)
- Novell 2.x, 3.x, 4.x Bindery Mode
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- UNIX (TCP/IP)
- Apple Ether/TokenTalk
- Windows NT (TCP/IP)
- Windows '95 (SEH PrintMonitor)
- BS2000 RSO Spool (V. 2.3A, V. 3.0A)



Hardware Support

Ethernet 10Base2/5/T/FL (BNC, AUI, RJ45, ST)

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- IC55-ETHERPOCKET
- IC57-ETHER-EPSON

Token Ring STP, UTP (IBM Type1/2, Type3)

- IC60-TOKEN-KYO

Ethernet 100BaseTX (RJ45)

- IC73-FAST-KYO-TX
- IC77-FAST-EPSON-TX

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NT Server 4.0 Enterprise Edition moves Windows NT a major step toward enterprise-level capabilities. By Morgan Stern and Gary Monti

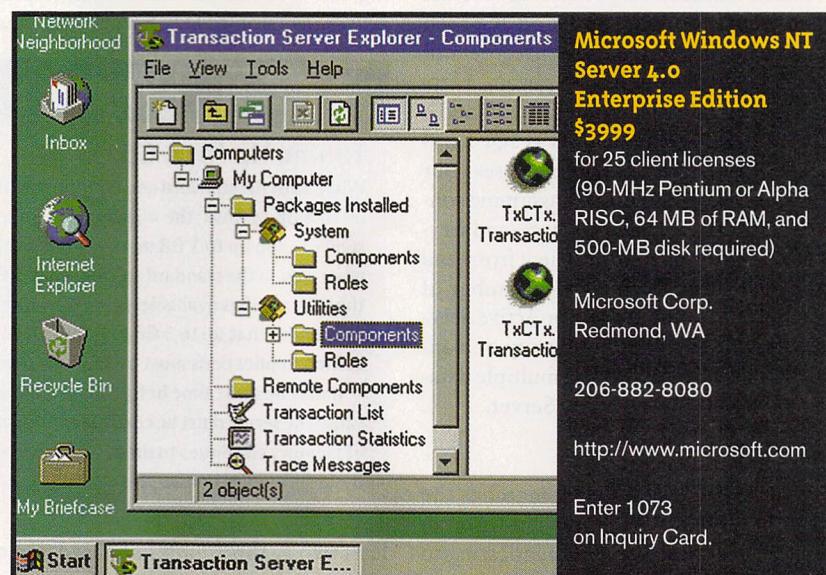
Microsoft Laces Up for the Enterprise Race

If you've ever seen an Olympian sprinter prepare for a race, then you've probably noticed the pre-race ceremony: a few quick warm-ups leading to a dramatic pause in the starting blocks just before the explosive dash to victory. If Windows NT 5.0 symbolizes the dash to victory for Microsoft, then Windows NT Server Enterprise Edition is the dramatic pause, an opportunity for Microsoft to gather its thoughts, make minor adjustments, and prepare for the effort ahead.

Enterprise Edition builds on NT Server 4.0 to fortify the OS for the rigors of enterprise computing. With this upgrade, Microsoft has made NT a more scalable, reliable, and manageable platform.

The upgrade has a number of notable changes, including support for up to eight processors on a single server and up to 32 processors in special OEM versions to be offered by hardware manufacturers. Another new feature, called 4GB Memory Tuning, increases the upper limit of memory that can be addressed by a single process from 2 GB to 3 GB for Intel-based servers with enough RAM (see the Tech Focus box on page 46). This RAM need not all be physical RAM; the extra address space can provide significant performance benefits for I/O-intensive applications, such as SQL Server.

Microsoft packages additional features of the Enterprise Edition as modules that can be installed separately or in combina-



The Microsoft Transaction Server is but one of the new components offered in the NT Server 4.0 Enterprise Edition.

also continues to bundle Internet Information Server (IIS) 3.0 and FrontPage 97 with the package. All these additional features are burned into a companion CD called the Component CD.

Safety in Clusters

Organizations looking for increased server availability can implement the Microsoft Cluster Server to construct a two-server, automatic fail-over configuration. In a cluster, if one server either requires service or crashes due to a hardware failure, the second server takes over from the unavailable unit and automatically restores any existing server connections. This represents Microsoft's Phase I philosophy for clustering. Load balancing and multinode clustering will both be addressed in phases II and III, with release dates yet to be announced.

To create a server cluster, you need a pair of network adapter cards to act as the

interconnection between the clustered servers. An external SCSI disk subsystem provides common storage for the two servers, each attached separately through an approved SCSI controller. Before buying any hardware, we recommend checking the Microsoft Cluster Server Hardware Compatibility List for components that have passed Microsoft's Cluster Validation Test, a subset of the standard NT 4.0 Hardware Compatibility List (HCL). This is viewable at <http://www.microsoft.com/hwtest/hcl>.

New Chrome and Tail Fins

The two other main Enterprise Edition components, the Message Queue Server and the Transaction Server, should appeal to enterprises planning to use NT as an application-development platform.

The Message Queue Server, an application-to-application messaging service, lets developers use the Microsoft Mes-

RATINGS

TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★

tion. Three important new ones are the Cluster Server (formerly known by its code name, "Wolfpack"), the Transaction Server (which was previously downloadable from <http://www.microsoft.com>), and the Message Queue Server. Microsoft

age Queue service to support asynchronous communications between a sender and a receiver passing data in any format that is understood by both parties. Because it's asynchronous, message queuing can work around any application and network failures. The queuing function stores messages during network or intermediate system failure, which allows it to maintain integrity while it determines whether to retransmit or reroute.

The Transaction Server provides high-volume transaction-processing services that permit developers to use off-the-shelf ActiveX controls to create three-tier client/server applications. By putting a layer between the client application and a server-based database, such as SQL Server, the Transaction Server increases your programming flexibility by assuming control of the interfaces to the back-end servers. Developers can create client front-end applications using any of a number of tools, such as Visual Basic or Active Server Pages, leaving the complexity of managing the interactions with multiple databases up to the Transaction Server.

Set It Up, Joe

The installation program matches the standard NT 4.0 process, right through the final reboot. Upon authenticating to the server for the first time, you encounter a mandatory Service Pack 3 (SP3) update. Cynics and mystics might ponder why the Enterprise Edition install wasn't integrated with the rest of the install, but once the process is completed, the Enterprise Installer launches and provides an interface for installation of the various packages contained on the Component CD.

Though inelegant, this installation procedure allowed us to upgrade a standard NT Server to the Enterprise Edition in less than 10 minutes. One quick system reboot later, and the server was up and running. Those with an eye for detail will notice that the Enterprise Edition build is identified as Build 1381, which is consistent with the current, standard release of Windows NT Server 4.0/SP3. SP3 always supported eight processors and 4-GB memory tuning, but the capabilities were kept in reserve until now, according to Microsoft.

Once you're past the Enterprise Installer, the package doesn't look much different than its predecessor except for the new splash screen identifying it as the Enterprise Edition. Component-package installations are straightforward. Microsoft

Cluster Server, Message Queue, and Transaction Server all follow the standard installation format for Microsoft products.

Wrap It Up, Take It Home

When Microsoft announced the Enterprise Edition at Scalability Day, it also announced availability of a special Enterprise Edition version of SQL Server. Naturally, corporations will want to implement both products as a pair so they can take advantage of the improved transaction processing. However, the release of the Enterprise Edition version of SQL Server will lag at

Front Page 97. As the number of technology updates and bug fixes increased, the time required to test all components extended dramatically, as did the time between Service Pack releases. By designating Service Packs as the exclusive vehicle for bug fixes, Microsoft hopes to resume a more regular release schedule—surely welcome news to administrators.

According to Microsoft, the components that will be unique to the Enterprise Edition are the changes to the core OS (i.e., support for up to eight processors and 4-GB memory tuning) and the Cluster

TECH FOCUS

RAM

Tuning Up for 4 GB

While both the standard and Enterprise Edition versions of Windows NT Server 4.0 can address up to 4 GB of RAM, the 4GB Memory Tuning (4GT) feature of Enterprise Edition allows the server to use up to 1 GB more RAM than the standard version allows for memory-intensive processes. In the standard version, up to 2 GB of memory is made available to processes, while the other 2 GB is available to the NT kernel. 4GT adjusts the way in which the server handles memory so that up to 3 GB of RAM can be used by processes, leaving the other 1 GB for the kernel. Applications must be specially modified to take advantage of 4GT.

It may be some time before most organizations will be able to take advantage of 4GT, because the server must be configured with at least 2 GB of physical RAM. However, as the price of memory continues to drop, such large amounts of RAM will likely become more common for large application servers.

least two to three months behind that of NT Server Enterprise Edition.

With the release of Enterprise Edition soon to be overshadowed by the impending arrival of NT 5.0, one has to wonder how this release fits into the NT product line. Adding to the confusion is Microsoft's decision to bundle versions of the Transaction and Message Queue servers into the first release of the Windows NT Option Pack.

Microsoft recently changed its Service Pack strategy to shorten the time between bug-fix releases. Starting with Service Pack 4, technology updates will no longer be included. Instead, they will be released as components of the Windows NT 4.0 Option Pack.

The Option Pack contains version 4.0 of IIS, version 2.0 of the Transaction Server, version 1.0 of the Message Queue Server, and the Routing and Remote Access Service (RRAS) update. In addition to being available as a low cost CD-ROM, the Option Pack will be available as a free download from the Microsoft Web site.

Before this change, all Service Packs up to and including SP3 contain bug fixes and technology updates, such as IIS 3.0 and

Server. In addition, the version of the Message Queue Server that ships with the Option Pack is a scaled-down one, lacking many of the features that ship in the Enterprise NT Server version. An Enterprise Edition version of NT 5.0 is expected to be released when the standard version ships.

For organizations that are looking to increase the performance and reliability of their NT servers, NT 4.0 Enterprise Edition will bring them closer to their goal. By offering features such as eight-processor support and the Cluster Server, Microsoft is taking an eagerly anticipated step toward offering a truly enterprise-worthy OS. However, organizations looking for other enterprise-type features, such as a true directory service, will have to wait for NT Server 5.0, which is due sometime later this year. **B**

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New smart phones incorporate both voice and data for e-mail and Internet access. By Michelle Campanale

Smart Phones Make the Grade

For the past year, smart phones have been little more than an overhyped idea. Now, after debuting in Europe early this year, these all-in-one hand-held devices for sending and receiving voice, e-mail, and Internet data are finally becoming available in the U.S.

Wireless phones with e-mail and Internet capability come in two flavors, one based on Global System for Mobile Communications (GSM) cellular networks, and the other based on Cellular Digital Packet Data (CDPD) networks. Three units were on the market at press time, and many vendors are starting production. I looked at Samsung and Mitsubishi units that work with CDPD 1.1. Nokia was unable to send its GSM-based Communicator 9000 in time for this review.

More Than Meets the Eye

I spent a week with Samsung's Duette and Mitsubishi's MobileAccess 120. I quickly realized that smart phones do not live by hardware alone. Many components make the smart phone tick, including the hardware itself, the cellular voice service, the cellular data service (which includes e-mail service and an address), a text-based Web browser, and content.

The only third-party application you may need is Puma's IntelliSync software for Pocket Net phones. It synchronizes desktop applications with those on the phone.

Luckily for me, AT&T Pocket Net Service packaged everything I needed to get the smart phone up and running, including AT&T's data service (Pocket Net), voice service, and Unwired Planet's UP.Link software platform and browser (which bundles a variety of Internet-related software and services). AT&T sells the phones for \$299 and unlimited use of the data service for \$29.95 a month. It



RATINGS				
TECHNOLOGY	★	★	★	★
IMPLEMENTATION	★	★	★	★
PERFORMANCE	★	★	★	★



RATINGS				
TECHNOLOGY	★	★	★	★
IMPLEMENTATION	★	★	★	★
PERFORMANCE	★	★	★	★

also provides voice service (in certain markets, at least) and bundles the connectivity software and pushed content.

Pull for Push

Setting up both phones to access Unwired Planet's pushed Internet content was simple. I downloaded the software on my laptop, registered each phone with a user name and password, and configured my personal information manager (PIM), calendar, and address book, which are stored on Unwired Planet's Handheld Device Markup Language (HDML) server. I configured each phone for the right LCD contrast, tone volume, and speed-dial numbers. I could check e-mail, the weather report, news, and even play a game of hangman on each unit.

Connecting to Unwired Planet's server to access this content was faster than I expected and surprisingly reliable. I connected at various times throughout the

day. The maximum connect time was 7 seconds. Another bonus was the time it took to get the information I needed. With a laptop, you must wait to boot up, spend time connecting to an Internet service provider (ISP), and navigate to the right Web site. With a smart phone, it took a matter of seconds to flip on the power and navigate to the stock quotes menu. If there's a killer application for smart phones, it's definitely push technology.

Besides using Pocket Net, the Mitsubishi and Samsung phones are similar in a few other ways. Both come with any-time technical and customer support. Both phones are similar in form and function. Each phone is full-duplex and provides Rivest-Shamir-Adleman (RSA) data encryption and IS-90 authentication. The two phones come with a PIM and a calendar, and have serial-port interfaces to their 19.2-Kbps CDPD modems. What differentiates these two phones are some

TECH FOCUS TECHNOLOGIES

CDPD: Here and Now

Almost every cellular carrier plans to convert its networks to digital technology in the coming decade. Various digital cellular voice technologies—time division multiple access (TDMA), code division/multiple access (CDMA), Global System for Mobile Communications (GSM), and Personal Communications Services (PCS)—are vying to replace Advanced Mobile Phone System (AMPS) as the U.S. standard for voice. Time will tell which one prevails. But for now, those who need digital wireless voice and data communications that are widespread, reasonably priced, and reliable can use the AMPS/CDPD (Cellular Digital Packet Data) combination.

The analog technology, CDPD, was standardized in 1993 and can transmit data at 19.2 Kbps. It uses the existing cellular infrastructure and works in the 800- to 900-MHz range of the radio spectrum. According to the CDPD Forum, CDPD is deployed in 151 domestic markets and over 30 international markets. It makes up over 50 percent of the U.S. market. Both the Mitsubishi and Samsung smart phones use CDPD 1.1 and overlay CDPD (used for data communications) onto AMPS (used for voice communications).

CDPD itself is a layered architecture that can be sandwiched between many different types of voice technologies, such as CDMA and TDMA. In fact, CDPD doesn't care which technology it is overlaid onto. Both CDMA and TDMA are currently being developed to work in conjunction with CDPD. However, specifications have only recently been set.

CDPD's advantages include the ability to use TCP/IP, which makes any CDPD modem a true IP node. The Mitsubishi and Samsung phones I tested have the ability to connect to a laptop (via a serial cable) and act as a packet modem (and in the Mitsubishi phone's case, a circuit-switched modem as well). There's also a broad range of development tools for CDPD. Unwired Planet's UP.Link Internet-access software uses an open language—Handheld Device Markup Language (HDML) 2.0—to develop applications.

key features and a few subtle details that contribute to each phone's usability.

Mobile Champ

The first thing that struck me about the Mitsubishi MobileAccess 120 phone was its backlit screen and keys. The entire key lights up, not just the number or letter on the key. With the Samsung Duette, the screen is also backlit, but only the numbers on the keys are lit. That's important, especially at night.

More important, though, the MobileAccess 120 has three user modes: voice, data, and dual. While I checked my e-mail, I was able to receive an incoming call. With the Samsung Duette (which has either voice or data modes only), incoming calls received a busy signal when I checked my e-mail. Both phones' 19.2-Kbps CDPD modem can connect to a laptop or via a special serial cable and serve as a packet modem. The MobileAccess 120 also has a 14.4-Kbps Advanced Mobile Phone System (AMPS) modem that you can use, in the same fashion, as a circuit-switched modem.

I liked being able to store 99 names and numbers in the MobileAccess 120's memory. On the Duette, the limit is 40. Additionally, the MobileAccess 120 has a few

empty memory slots for future expandability and to accommodate future enhancements and new applications.

The Mitsubishi smart phone is well thought out, gaining extra points for its viewability. In voice mode, the phone's display shows a large battery-indicator picture, in addition to date and time displays. (The Duette does not show the date and time while in voice mode and has a very small battery indicator.) The MobileAccess 120's

PRODUCT INFORMATION

AT&T Pocket Net \$29.95 a month for data services (PC and Mac)	408-730-5900 http://www.mobileaccessphone.com Enter 1071 on Inquiry Card.
AT&T Wireless Services Kirkland, WA 888-299-8558 425-803-4000 http://www.att.com/wireless/data/ Enter 1070 on Inquiry Card.	Samsung Duette \$299 (standard bat- tery, adapter, desktop charger) Samsung Telecom- munications America Richardson, TX 888-987-4357 972-761-7000 http://www.sec.samsung.co.kr/Telecom/product/wireless/mobile/shp10.html Enter 1072 on Inquiry Card.
Mitsubishi MobileAccess 120 \$299 (standard bat- tery, adapter, trickle charger) Mitsubishi Personal Mobile Communications Division Sunnyvale, CA	

viewability is also improved by its use of big fonts. The Duette's screen is larger, but it wastes a lot of its space and uses small fonts.

I also liked Mitsubishi's Power Navigating tools, which are basically shortcuts. By pressing down on and holding a number, I was able to avoid having to press enter after each number when navigating the menus. Another neat feature is the phone's voice mute button (to temporarily block your voice when you're talking on the phone). Finally, the MobileAccess 120 has a slightly smaller form factor than the Duette. It stored easily in my pocket. All this, in addition to its backlit keys, large memory storage, dual data and voice modes, and good viewability, earn the Mitsubishi MobileAccess 120 recommended status.

Separated at Birth

With a keypad astonishingly similar to my TV's remote control, the Samsung Duette has a familiar look and feel. This interface makes it quick and easy to get acquainted with the phone's voice and data menu systems. It has soft phone keys and arrow keys for all four directions (the MobileAccess 120 has only up and down keys). Its learning curve is a bit easier than the Mitsubishi phone, due to its intuitive keypad. In truth, though, it's not easy sending e-mail using the small keypad on either phone.

A key differentiator of the Duette is the desktop charger that comes standard with the unit. It recharges in less than 40 minutes. The Mitsubishi phone comes with a trickle charger that takes 8 hours to charge.

Both phones have audio controls, which is important because all keypad action is accompanied by a sound. The MobileAccess 120's tones are shrill and high-pitched. The Duette's tones are more bearable, especially if you've used the keyboard for a long time.

I didn't like the fact that the Duette has only two modes: voice and data. The fact that you can't use these two modes simultaneously, as you can on the Mitsubishi phone, is a major minus. During my tests, incoming calls were unavailable to me, in real time, when I used the Duette to access the Internet or check e-mail. Though the Samsung Duette has a familiar interface, fast battery charger, and nonannoying tones, it is less feature-rich, overall, than the Mitsubishi MobileAccess 120. ■

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Making corporate data useful for decisions requires a processing hub that coordinates and controls data flows. By Colin White

Managing Data Transformations

Organizations are generating and gathering more data than ever before. The increasing use of the Internet and corporate intranets is also adding to the mountain of available business data. But more data does not necessarily mean better information or more informed business decisions. Often data accumulates so rapidly that organizations have difficulty managing its accuracy and quality.

For corporate decision-making, business users need access to clean and consistent data. The best solution is to build a business information system that provides high-quality, consistent data. Its key parts are shown in the figure at right.

Regardless of whether data flows from operational systems to a data-warehousing (DW) system, or from older operational systems to reengineered or downsized ones, the requirement is the same: A tool is needed to capture, clean, transform, and integrate data while at the same time handle the volume and complexity of the disparate data sources and targets involved. Such a tool is used with other software products and processes to form a Data Transformation Management System (DTMS). But before we can understand the DTMS's function, we must first understand how a business system works.

On the Line

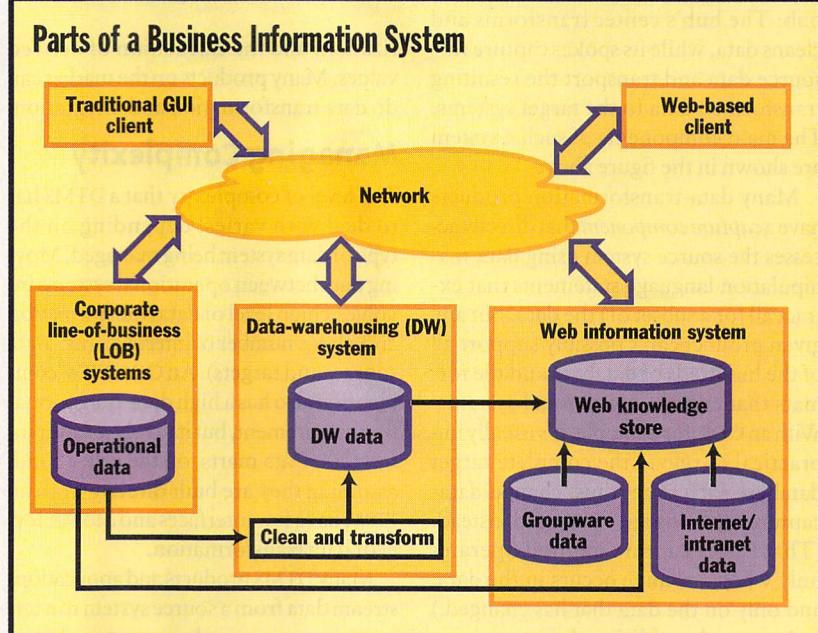
Corporate line-of-business (LOB) systems manage the day-to-day business operations of an organization: order entry, inventory management, shipping, invoicing, and so forth. These systems are designed with performance, rather than the business user, in mind. This is why users have never held LOB decision-support systems in high regard; they don't provide the consistent, easy-to-use information needed to analyze business operations or to make business decisions.

A DW system helps solve the deficien-

cies of LOB-based decision-support systems. A DW's objective is to capture corporate data from operational systems, clean it, and transform it into a consistent form that's understandable and has business context for the end user.

There are several types of DWs. One is the *enterprise data warehouse* (EDW),

An *operational data store* (ODS) presents a subject-oriented, integrated, consistent picture of current data stored in LOB databases. As data is modified in operational systems, a copy of the changed data flows into the ODS. The copy updates existing data to reflect the current status of the operational system. Updates



Information systems obtain data from various sources and repackage it for different uses.

which contains detailed (and possibly summarized) data that's captured from one or more LOB systems and integrated into a separate subject-oriented database. Data flowing into an EDW does not replace existing data; instead, it accumulates to show a historical record of business operations. This allows analysis of business trends over a period of time. This style of warehouse is used for short- and long-term business planning and decision-making covering multiple business units.

to the ODS typically occur less than 24 hours after updates to the LOB systems are completed. Unlike an EDW, an ODS does not contain summarized or historical data. Since it's used for the day-to-day management of business operations, an ODS can be thought of as an operational data warehouse.

A *data mart* contains a subset of corporate data that's of value to a specific business unit, department, or set of users. This subset consists of historical, sum-

marized, and possibly detailed data captured from LOB systems (independent data marts) or from an EDW (a dependent data mart). Like an EDW, a data mart is used for short- and long-term business planning and decision-making; unlike an EDW, a data mart does not provide the capability to analyze data across multiple business units of an organization.

A *Web information system* integrates data from LOB, DW, and groupware systems (e.g., Lotus Notes and Microsoft Office) with data stored on Web servers connected to a corporate intranet and the public Internet. Such a system extends the notion of a DW system to include all types of data that's of interest to a business user, making it accessible from Web-based desktop and network computers.

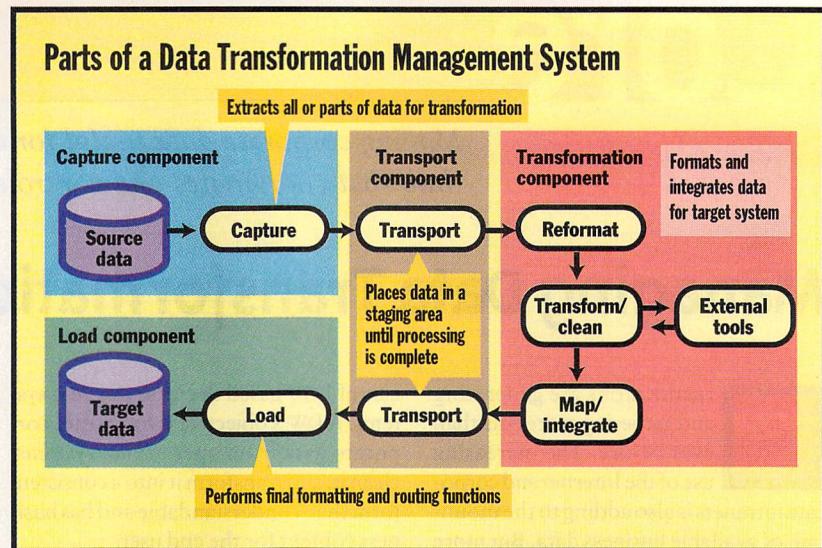
Building a DTMS

A DTMS acts as a data-transformation hub: The hub's center transforms and cleans data, while its spokes capture raw source data and transport the resulting transformed data to the target systems. The main components of such a system are shown in the figure above.

Many data-transformation products have a *capture component* that directly accesses the source system using data-manipulation language statements that extract all (or a subset of) the data. But any given product can't possibly support all of the hundreds of database and file formats that exist in operational systems. With an ODS, for example, it's usually impractical to reload the complete target database each time; thus, change-data-capture methods are often used instead. (That is, the capture method operates only when a change occurs in the data, and only on the data that has changed.)

As a result, additional data-capture routines might have to be used in some situations to create flat files that can be processed by a transformation tool. If data needs to be cleansed, then appropriate procedures and products need to be identified to do the work.

A *transformation component* formats and integrates data for a target system. This might involve the restructuring of the source data, including files, records, and fields, and the removal of data that the target system doesn't require. It may also involve enhancing the data by decoding and translating field values, adding a time stamp (if one is missing) to reflect the currency of data, data summa-



A DTMS is responsible for acquiring, synchronizing, cleansing, and distributing business-critical data.

ization, and the calculation of derived values. Many products on the market can do data transformation and integration.

Managing Complexity

The level of complexity that a DTMS has to deal with varies, depending on the type of data system being managed. Moving data between operational systems involves a high level of data transformation and a large number of interfaces (i.e., data sources and targets). An ODS/EDW combination also has a high data-transformation requirement, but it involves fewer interfaces. Data marts, on the other hand, assuming they are built directly from an EDW, have few interfaces and a lower level of data transformation.

Many DTMS products and applications stream data from a source system to a target system; as records are captured, they are transformed and loaded into the target system. But as the number of sources increases, the streaming approach is inappropriate because it becomes difficult to coordinate the capture of source data and to handle error recovery. Also, streaming approaches encourage the development of point-to-point solutions where data is moved from a single source database to a single target database, which leads to data-consistency problems.

The solution to these issues is to implement a *transport component* that routes captured data into a staging area and passes it to the transformation process only when all the required data has been cap-

tured. Similarly, the transport component holds output from the transformation process in a staging area until all the data has been transformed and is error-free.

A *load component* performs any last data formatting for the target system. It might also do routing functions that deliver data to one or more target systems.

Planning a Course

The main objective of a DTMS is to manage the flow of data from a source system to a target system. When choosing DTMS products, it's important to realize that the transformation power and interface management provided by a DTMS directly affect data quality and the ability of the product to adjust to support the needs of a corporate information system.

As complexity increases, DTMS tools are also required for configuration management, security and auditing, monitoring and tuning, transformation scheduling and work flow, and error recovery. To deploy high-performance, scalable business information systems, organizations must develop a sound DTMS architecture that supports not only existing LOB systems but the new multimedia data types that will appear in the future. **B**

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Powerful CPUs and cheap memory let PCs do speech synthesis and voice recognition using software alone. By Joseph J. Lazzaro

Speech Enables the Common Desktop PC

Thirteen years ago, I wrote a review of several speech synthesizers for BYTE ("The Search for Speech," December 1984). At that time, the speech market was a very different place. Prices were steep: You could fork over as much as \$4000 for a high-end text-to-speech synthesizer, or as much as \$10,000 for a turnkey voice recognition package. Vendors could command such prices because, at that time, speech generation and recognition required expensive, custom hardware. Few speech-technology standards existed.

Now, I'm happy to report that times have definitely changed. Thanks to the standardization of sound hardware and to more powerful computer platforms, software-based speech synthesis and recognition have moved squarely into the mainstream. People can now get powerful speech synthesis and recognition technology at bargain-basement prices. (For example, IBM's Simply Speaking Gold voice recognition and text-to-speech package costs only \$99.) More important, people with visual or learning disabilities can now purchase a computer from a superstore and use it immediately, without purchasing additional hardware.

From Toy to Tool

How did this change come about? For starters, processors got a lot faster over the past decade. A PC with a 133-MHz Pentium, or even a 200- or 233-MHz CPU, is not uncommon. These chips deliver sufficient computing power so that speech processing can be handled by software rather than by hardware. A possible show-stopper to using software for speech operations is that both the speech generation and the speech recognition algorithms require ample memory to store and process wave forms. However, today's low DRAM prices have helped the

situation: Many out-of-the-box PCs are tricked out with a basic 32 MB of RAM. It only costs about \$200 to double that capacity to 64 MB.

Another crucial change is that a de facto hardware standard has emerged for sound generation and capture on PCs, eliminating the installation and support problems created by a morass of different hardware configurations and drivers.

longer a daunting task. Furthermore, there's more than enough memory and processing power left over for the OS and applications to run smoothly. Because of this, major speech-technology developers like IBM, Kurzweil, AT&T, and Dragon Systems have migrated from proprietary speech cards toward the ever-present Sound Blaster hardware.

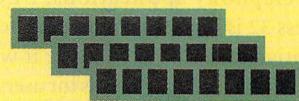
In the API arena, a set of solid standards

Reading the Screen

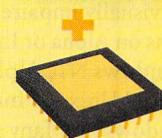
Screen readers are programs used by people who are blind or visually impaired to operate a computer. These programs examine data going to the screen buffer and present any text strings on a braille display or use one of the voice synthesis programs to speak the text aloud. Many of these screen readers support the Sound Blaster card and software-based text-to-speech synthesizers, such as Digital Equipment's DECTalk.

Speech Technologies Brought About by:

Inexpensive RAM to store wave forms for speech processing



More powerful CPUs (Pentium, Pentium Pro)



De facto Sound Blaster standard provides consistent low-level interface for sound input and output.



Creative Labs' Sound Blaster card has become the recognized speech and audio standard for the Windows platform. The company claims it has 20 million cards installed worldwide. You can't purchase a PC today without a sound card inside, and chances are it will be a Sound Blaster, or Sound Blaster-compatible. The Sound Blaster comes bundled with its own native text-to-speech and recognition engines in the form of TextAssist and VoiceAssist, respectively. With a high-speed Pentium processor and 32 megabytes of RAM, running speech synthesis or recognition engines concurrently is no

that support speech for a wide variety of applications is emerging. The Microsoft Speech Application Programmers Interface (SAPI) is a standard programming interface for speech technologies on the Windows platform. SAPI provides support for both voice synthesis and speech recognition. By writing SAPI-compliant code, developers gain the ability to mix and match technologies from any of the vendors that provide SAPI-compliant speech engines. SAPI is based on the Component Object Model (COM), so it can be accessed from a number of languages and development environments, including

Visual C++, Visual Basic, Visual J++, as well as development environments from other vendors that support COM. The point to remember is that SAPI lets you choose the speech engine or product that is most useful for your needs.

Speak to Me

Text-to-speech synthesis engines convert text into the spoken word in real time. Speech engines can take notice of punctuation, capitalization, numbers, even international conventions for time, currency, and date. Numerous speech synthesis engines and products are on the market, with one suited to almost every requirement. Here are some representative examples.

Digital Equipment Corporation has long been a major player in the speech business. DEC offers speech products for different markets and applications. The company supports its proprietary DECTalk hardware technology, as well as software solutions. DECTalk Software is a text-to-speech engine that features nine voices and has an unlimited vocabulary. DECTalk can also generate DTMF tones for telephony applications. DECTalk Access 32 is under development for the adaptive technology market; it will be used to produce speech aids for users who are blind or visually impaired. DECTalk Software runs on Alpha or Intel systems running Windows NT, Alpha systems running Digital Unix, or Intel systems running Windows 95. Many speech synthesis products work with the DECTalk Software engine.

The Productivity Works offers pwWebSpeak, a talking Web browser. The program reads Web pages in an understandable robotic voice, speaking links automatically as a page is read. The software supports voice synthesizers that use a Sound Blaster-compatible card. It requires 8 MB of RAM and runs under Windows 3.1 and Windows 95.

Voice Recognition Products

Voice recognition engines process the spoken word, converting verbal commands into computer commands. Many voice recognition products are available for the PC platform. You can use voice recognition to control the Windows desktop, dictate documents, or both.

NaturallySpeaking, from Dragon Systems, is a voice dictation system that performs continuous speech recognition. You can dictate documents into your computer, then cut and paste the text into your word processor. You do not need to deliberately pause between words, so data entry is faster. NaturallySpeaking requires a PC equipped with a 166-MHz Pentium processor; it runs faster on MMX machines. The software needs 32 MB under Windows 95, 48 MB under Windows NT 3.51 and 4.0, and 60 MB of free hard disk space. NaturallySpeaking also requires an industry standard 16-bit Sound Blaster-compatible card or, on portables, a built-in sound system. It comes bundled with a headset-style microphone. NaturallySpeaking has a 30,000-word memory-resident active

vocabulary and a disk-based 200,000-word backup dictionary.

Kurzweil Applied Intelligence is one of the major players in the speech arena. The company offers several voice recognition products for PCs. VoicePad is a voice dictation system with a 20,000-word active vocabulary and a disk-based vocabulary of 200,000 words. Under Windows 3.1, the software requires a 75-MHz 486 processor or faster. Running under Windows 95, a Pentium processor is required. The system also needs 8 MB of RAM for the voice application and 20 MB of disk space. The program requires a 16-bit Sound Blaster-compatible card.

IBM has long been one of the leading developers of voice technology. Simply Speaking Gold is a combination voice recognition and text-to-speech engine from IBM for Windows 95 and Windows NT 4.0. The package combines voice command-and-control functions with voice dictation. It also includes VoiceType Connection for Netscape, which enables voice-directed Web browsing using Navigator 4.0. Simply Speaking Gold requires a 100-MHz Pentium system, 16 MB of RAM for Windows 95 (32 MB for Windows NT 4.0), 46 MB of disk space, and a Sound Blaster card.

Famous Last Words

Since the personal computer was born, speech technology has made tremendous strides, slowly working its way from games to the office desktop, with prices dropping all the while. Faster Pentium-class computers and 32 megabytes of memory provide a solid platform for running speech applications. The Sound Blaster card and its clones provide the audio component at a cost-efficient price. Clearly, the goal of many speech developers is to make their products available to the consumer market, which means you'll start seeing more speech-enabled applications in the computer stores. Many of these products will be in the \$100 to \$200 range. Speech has put itself squarely in the mainstream, and the technology has taken a giant step toward replacing the keyboard. **B**

WHERE TO FIND

Speech processing

DECTalk Software
Digital Equipment Corp.
Littleton, MA
800-344-4825
fax: 800-234-2298
<http://www.digital.com/oem/products/dectalk/dectalk.htm>

NaturallySpeaking
Dragon Systems, Inc.
Newton, MA
617-965-5200
fax: 617-527-0372
<http://www.dragonsys.com/>

pwWebSpeak
The Productivity Works, Inc.
Trenton, NJ
609-984-8044
fax: 609-984-8048
<http://www.prodworks.com>

Simply Speaking Gold

IBM Direct
Atlanta, GA
800-426-2255
fax: 800-242-6329
<http://www.software.ibm.com/>

VoicePad

Kurzweil Applied Intelligence, Inc.
Waltham, MA
781-893-5151
<http://www.lhs.com/kurzweil>

Screen readers

Automated Screen Access Program (ASAP) for Windows
MicroTalk
Texarkana, TX
903-792-2570
fax: 903-792-5140
<http://www.screenaccess.com>

JAWS for Windows

Henter-Joyce, Inc.

813-803-8000
fax: 813-803-8001
<http://www.hj.com/>

Slimware Window Bridge

Syntha-Voice Computers, Inc.
Stoney Creek, Ontario, Canada
905-662-0565
fax: 905-662-0568
<http://www.synthavoice.on.ca/>

Window Eyes

GW Micro
Fort Wayne, IN
219-489-3671
fax: 219-489-2608
<http://www.gwmicro.com>

WinVision

Artic Technologies
Troy, MI
248-588-7370
fax: 248-588-2650
<http://www.artictech.com/>

Joseph J. Lazzaro (lazzaro@world.std.com) is the author of Adapting PCs for Disabilities (Addison-Wesley, 1996). He is also project director of the Adaptive Technology Program housed at the Massachusetts Commission for The Blind, in Boston.

To safely connect your ATM network to the outside world, carefully consider its addressing scheme. By Jeffrey N. Fritz

Demystifying ATM Addressing

With so many asynchronous transfer mode (ATM) networks being deployed these days, issues such as ATM address assignments are becoming a major headache for network administrators. Unfortunately, the concept behind the ATM End System Address (AES) is not always clear, and the multiplicity of ATM addressing schemes tends to confuse users. Registration, another facet of ATM addressing, is often completely overlooked. This article will shed some light on these concepts and suggest how to use this information to best build and manage your own ATM network or backbone.

Comes in Three Flavors

The most vexing part of managing ATM addresses is the medley of address formats. The International Telecommunication Union (ITU), an international standards body, bases the addressing structure of public ATM networks (i.e., B-ISDN) on telephone-style E.164 addresses.

For private networks, the ATM Forum has defined no less than three flavors of ATM address formats to specify a network device's end address. All three formats are 20 bytes long and are similar in structure to an ISO Network Services Access Point (NSAP) address. The three formats are the Data Country Code (DCC), the International Code Designator (ICD), and NSAP encapsulated E.164, as shown in the figure at right.

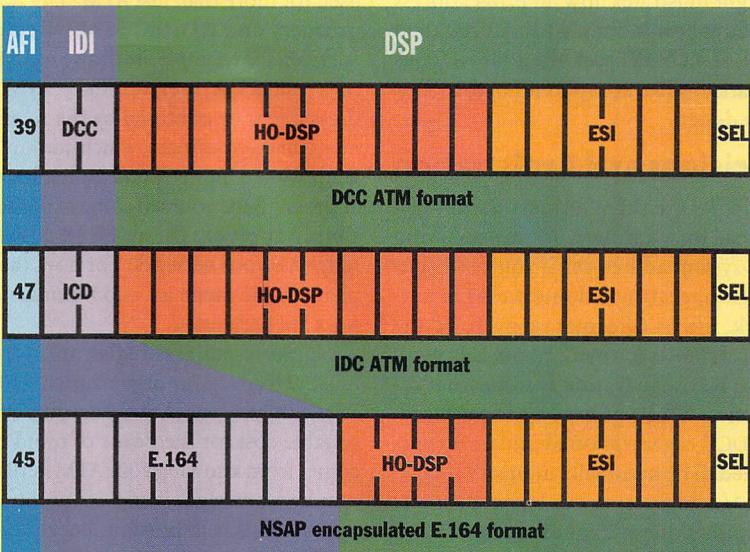
Each address consists of three parts. The first, the Authority and Format Identifier (AFI), indicates the type of addressing scheme used. The second part, the Initial Domain Identifier (IDI), describes the address allocation and administration authority. The final portion is the Domain-Specific Part (DSP), which contains routing information.

The DCC format supports the IEEE 802 address recommendations. This makes

the format very LAN-oriented. The value of AFI for the DCC format is 39. The IDI serves as a country code; for the U.S., it's 840. Since the IDI consists of three dec-

the address, then by a 6-byte End System Identifier (ESI) and a selector byte. The ESI is usually the IEEE 802 MAC address of the device. You can use the selector byte

Private ATM Address Formats



AFI = Authority and Format Identifier

IDI = Initial Domain Identifier

DSP = Domain-Specific Part

HO-DSP = Higher Order Domain-Specific Part

ESI = End System Identifier

SEL = Selector byte

A network administrator has three address formats to pick from for local ATM network addresses.

imal digits encoded into octets, the final semi-octet is padded with 1111 (hex F) to obtain an integral number of octets. Therefore, every DCC address issued in the U.S. starts with 39.840F.

Following the IDI field is the Higher Order Domain-Specific Part (HO-DSP). This part has an organization identifier (not shown in the figure), which is a company code assigned to the user. It's followed by the user-designated portion of

when operating a LAN Emulation Server (LES) and a Broadcast and Unknown Server (BUS) in the same ATM switch. Because the LES and the BUS have the same general address but a different selector byte, this differentiates the two LAN emulation (LANE) services running on the same switch.

The ICD format was defined by the ISO for the Open Systems Interconnection (OSI). Following the AFI (which has a val-

ue of 47) is a preassigned IDI field, then the HO-DSP field. From the user part of the HO-DSP onward, the ICD format is nearly identical to the DCC format.

NSAP encapsulated E.164 differs from the other formats because it's based on a telephone-numbering plan. The AFI equals 45, while the IDI field consists of an E.164 number, whose format varies slightly from country to country. In North America, the field after the AFI contains the Numbering Plan Area (NPA), which is more commonly known as the area code. (In other countries, the country code appears in this field instead.) Following this is the NXX, which is also known as the central office exchange. (In other countries, the city code goes in this field.)

Finally, the local subscriber number appears. The text box "E.164 Numbers" at right illustrates how an E.164 address would appear in both North America and the U.K. In both cases, the address looks remarkably like a telephone number. This is by design.

Decisions and Registration

Which of the three formats should you choose for your network in specifying end-system addresses? If you're designing or operating a domestic ATM network, the DCC format seems to be the logical choice. It's more commonly used, since ICD registration is somewhat restrictive. When properly administered, the DCC organization identifier is guaranteed to be nationally unique.

E.164 addressing can be problematic because it doesn't appear to have a stable telephone-number base, particularly with increased line utilization forcing

numerous area-code and line-number changes. Bear in mind, however, that eventually carriers will begin using E.164 addressing. If your private network uses DCC- or ICD-formatted addresses, you might need to do some form of address conversion between your network and your carrier's public network.

How do you get an AESA? The ATM Forum has defined two sources. The first is a service-provider address—where the service provider owns the address, but a portion of the address space is allocated to the customer. The second type is a customer-owned address. Here the customer, or end user, obtains an address range directly from a registration authority. See the text box "Getting Registered" below for more information.

Be aware that NSAP-style addressing is used for more than just ATM. The X.500 protocol and ISO/IEC 9594 Directory Services, for example, both also use NSAP addressing. Users registering an ATM address might be confused by the requirements of these services, which add an "organizational numeric and alphanumeric address." Save yourself some expense by simply applying for an NSAP numeric range for your network. For now, the alphanumeric range isn't commonly used for ATM networks.

Numeric-address registration from ANSI will cost your organization \$1000. While this isn't pocket change, it's a reasonable cost for the peace of mind that comes from knowing your ATM network numbers are registered with an official agency. This is important, because network administrators who would never consider rolling their own Internet ad-

E.164 Numbers

For North America

Country code = 1
(assigned by the ITU)

Numbering Plan Area (NPA) =
area code = 304

NXX = office code = 293

Subscriber number = 1234

E.164 address: 13042931234

For the U.K.

Country code = 44

City code = 171 (London)

Local number = 937 1234

E.164 address: 441719371234

resses don't give a second thought to creating their own ATM addresses. This is analogous to creating your own IP address range.

Admittedly, this is not a problem with stand-alone networks. However, as with TCP/IP, connecting networks with the same ATM address range creates conflicts because one or more ATM devices have duplicate addresses.

If you have a registered address, theoretically no one else can legally use the same address numbers that your network uses. If you run into address conflicts with another interconnected ATM network, you won't be the one required to change your address hierarchy. (Readressing large switch hierarchies is a daunting and time-consuming task.)

You should consider ATM-address registration as early as possible in the design process—even if your network is initially constructed as a private subnet. ATM networks, just like Ethernet and Token Ring networks, won't remain private networks for very long. **B**

Acknowledgment

I'd like to thank Bob Lynch, senior system consultant for Digital Equipment Corp. and acting chair of ANSI's Registration Advisory Committee, for his assistance with this article.

Jeffrey N. Fritz is a telecommunications engineer for West Virginia University and author of Remote LAN Access: A Guide for Networkers and the Rest of Us (Manning Publications/Prentice-Hall PTR, 1996). You can reach him by sending e-mail to jfritz@wvu.edu.

Getting Registered

In the U.S., the American National Standards Institute (ANSI) has NSAP-address-registration authority. This authority comes from the global registration process established by the ISO and the ITU. You can find information on ATM NSAP-address registration from the ANSI Web site (<http://www.ansi.org>). The direct address to the "ANSI Registration Fact Sheet" is <http://www.ansi.org/regfact.html>. ANSI plans to change its Web site in the future, so you may need to look under the ANSI Services heading for the Registration link.

On the Fact Sheet page, you'll find registration information, including procedures for registering. This page also has pointers to an application form and a fee schedule. If you prefer, you can contact ANSI directly to obtain a Request for Registration application form. The voice phone number is 212-642-4884; the fax number is 212-398-0023. For e-mail use, the address is mmaas@ansi.org.

If you're building a network in a country other than the U.S., there's likely to be a national standards organization coordinating ATM addresses. If you don't know what the responsible organization in your country is, contact the ITU at <http://www.itu.ch>.

A one-chip MPEG-2 codec makes DVD authoring on a PC possible. By *Les Kohn and Greg Efland*

Making Personal Video a Reality

As early as next year, certain PCs will have recordable Digital Versatile Disc (DVD) drives. Even at 4.7 GB per single-sided, single-layer disc, a recordable DVD stores only 4 minutes of high-quality, uncompressed digital video. Fortunately, the latest compression standard from MPEG, MPEG-2, can compress a digital video stream so that a DVD holds over 2 hours of quality video.

In theory, a PC equipped with such a drive could become a video authoring system. Practically, MPEG-2's own capabilities have hampered its deployment. That's because the technology is asymmetric. Decompressing an MPEG-2 video stream requires only modest processing power (ideal for consumer devices), but encoding (or compressing) a video stream requires lots of processing power. Until recently, you needed costly multiprocessor arrays or custom hardware to achieve MPEG-2 encoding and editing in real time.

A low-cost processor from C-Cube Microsystems, the DV^X, changes the situation. It is a 0.35-micron, 3.3-V part that contains 5.4 million transistors, packaged in a 352-pin ball-grid array (BGA). While the DV^X operates at a modest 100 MHz, it performs professional-quality, real-time MPEG-2 encoding using only one-fourth the data rate of today's DV and M-JPEG video formats.

This lets a PC capture, encode, and store digital video on its standard hard disk or a recordable DVD, rather than use a dedicated disk array. Because the DV^X combines MPEG-2 encoding/decoding and video-effects functions on a single chip, it makes MPEG-based, frame-accurate video editing available to the serious consumer for the first time.

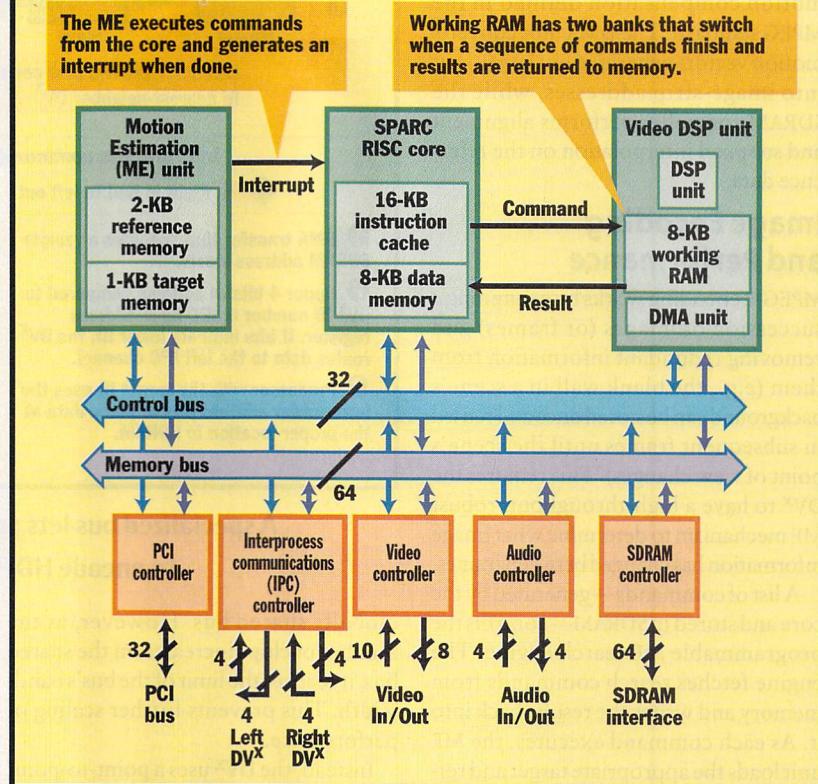
DV^X Architecture

The DV^X architecture is based on the experience obtained from three previous

encoder generations. Internally, the DV^X consists of several semi-independent units, as shown in the figure "The DV^X Microarchitecture." A SPARC RISC core performs high-level processing, complemented by motion estimation (ME) and

based architecture lets you add new features or correct bugs without changing the hardware. A 16-KB instruction cache ensures that no cache misses occur in major processing loops. The DV^X has an on-chip 8-KB data memory that's man-

The DV^X Microarchitecture



The various units operate concurrently to capture and encode digital video on the fly.

video digital signal processor (DSP) units that handle compute-intensive, low-level processing. All these parts work concurrently to perform the operations required for real-time encoding.

The core acts as a microcontroller and operates at 80 MIPS. This software-

aged by overlapped software-controlled DMA transfers. This replaces the traditional data cache to guarantee real-time performance.

The video DSP is a high-level coprocessor extending the SPARC instruction set to include image-processing and encoding

operations. Its nearly autonomous operation lets the DV^X use a less complex and smaller single-scalar core. The video DSP coprocessor consists of a DMA unit and a DSP unit, each connected to a double-buffered working memory composed of two banks of 4 KB each. At any given moment, the DMA unit is both loading new operands into one memory bank and storing prior results from it, while the DSP unit processes data in the other bank.

When the DMA and DSP units complete their tasks, the roles of the two banks are reversed. This lets video DSP operations overlap with the synchronous DRAM (SDRAM) data transfers necessary to sustain their throughput.

DMA-unit instructions load and store rectangular subsections (i.e., strips) of an image between working memory and the external SDRAMs. One strip-load instruction implements the various flavors of motion compensation defined in the MPEG standard. The DMA unit converts motion vectors generated by the ME unit into image-strip addresses, while the SDRAM controller performs alignment and subpixel interpolation on the reference data.

Image Encoding and Performance

MPEG-2 encoding works by examining a succession of images (or frames) and removing redundant information from them (e.g., the blank wall in a scene's background can be stored once and reused in subsequent frames until the scene's point of view changes). This requires the DV^X to have a high-throughput, robust ME mechanism to determine what image information has changed between frames.

A list of commands—generated by the core and stored in SDRAM—controls the programmable ME search engine. The engine fetches search commands from memory and writes the results back into it. As each command executes, the ME unit loads the appropriate target and reference image data from SDRAM into its on-chip target and reference window memories. These memories are double-buffered to allow the next target's SDRAM accesses to overlap with the search for the current target.

After all the search commands have been processed, an interrupt notifies the core. The command results might generate more search commands for the next level in a hierarchical search or perform

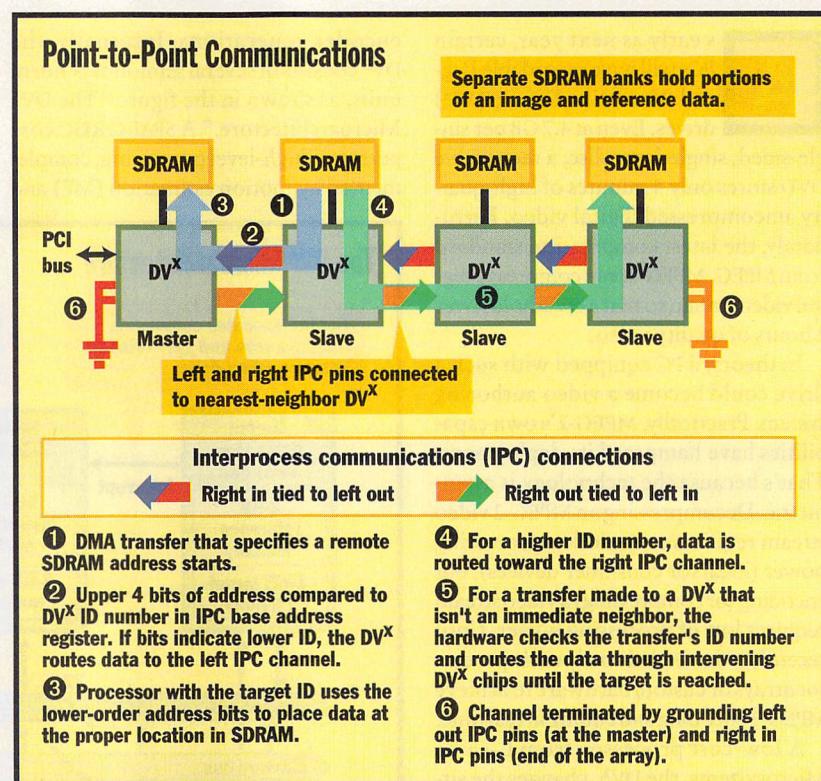
motion compensation in the video DSP. Although the ME unit off-loads much of the burden from the core, microcode retains full control of the critical search parameters. This gives the flexibility of a CPU-controlled search engine, but with the performance of a hard-wired engine.

To encode high-resolution formats such as HDTV, multiple DV^X processors can operate in parallel to divvy up the processing task. Previously, video-processing chips were interconnected by a

essary to encode an HDTV 1080I format. (It takes only two DV^X chips to decode all HDTV video formats.)

System Configuration

The DV^X provides glueless interfaces to several of the PC's subsystems. It has a 32-bit PCI host bus interface (revision 2.1-compliant), a programmable CCIR-656 (parallel D1) video interface, and an eight-channel I²S-compatible audio I/O interface. The DV^X uses 8 MB of SDRAM,



A specialized bus lets processors work in parallel to encode HDTV video formats.

globally shared bus. However, as the number of chips increases on the shared bus, it reaches the limit of the bus's bandwidth. This prevents further scaling of performance.

Instead, the DV^X uses a point-to-point architecture that scales directly with the number of chips. The DV^X chip's interprocess communications (IPC) channels can be interconnected to build multi-processor arrays, as shown in the figure "Point-to-Point Communications" above. Through the IPC ports, multiple DV^X chips coordinate processing operations so as to encode all proposed digital HDTV formats. Two DV^X chips can encode the 525P format, and eight to 10 chips are nec-

essary to encode an HDTV 1080I format. (It takes only two DV^X chips to decode all HDTV video formats.)

comprised of four 16-Mb parts. Because you don't need external first-in/first-out (FIFO) buffers and other logic, the DV^X further reduces the cost of adding the chip to a PC. To make systems capable of encoding and manipulating HDTV video formats, you simply add the DV^X chips you need, depending on the target audience. With recordable DVD, a DV^X PC offers professional-quality MPEG-2 video recording and authoring at entry-level prices. **B**

Les Kohn (editors@bix.com) is chief architect of C-Cube Microsystems' DV^X family of processors. Greg Efland (editors@bix.com) is the chief architect of the DV^X.

DHTML zooms objects in and out, makes them appear and disappear, and allows many multimedia effects. By Rick Dobson

Dynamic HTML Explained, Part II

This month's installment demonstrates why the *D* in DHTML stands for *dynamic*. With DHTML, it's easy to create effects that before would have required Java applets or ActiveX controls. Last month's article introduced this topic by discussing dynamic styles. We extend the theme this month by showcasing DHTML techniques for dynamic positioning, dynamic content, and multimedia effects.

Dynamic positioning refers to the capacity to move and size text and graphics on an HTML page. Dynamic content expands on this capability by letting authors change the content of text and graphics on a screen. You can even have the other HTML content automatically reflow as you make content appear and disappear again. Multimedia effects offer filters for transforming the appearance of content.

Dynamic Positioning

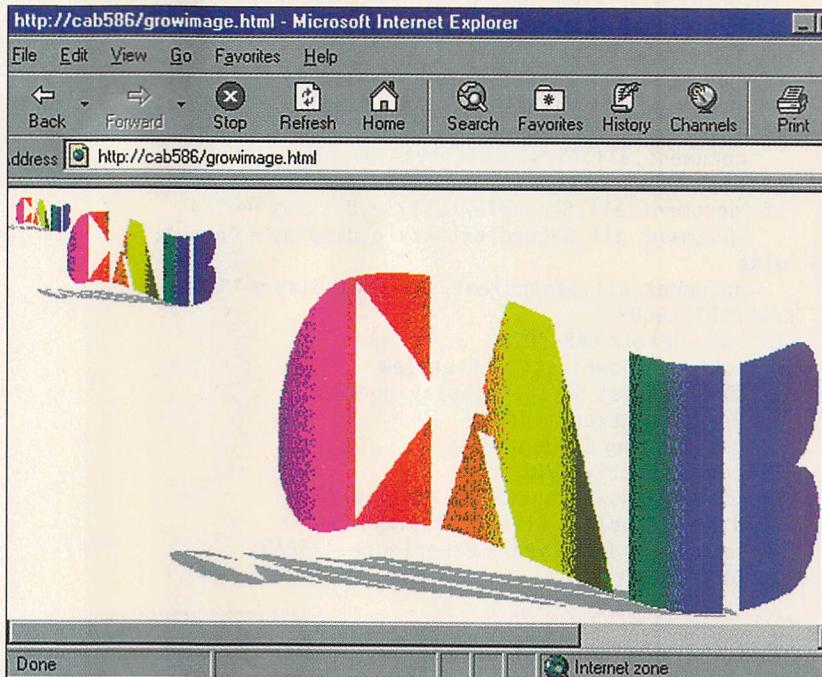
Dynamic positioning offers a three-dimensional coordinate system for controlling the display of HTML elements. Authors can also alter the display size of HTML elements through dynamic positioning attributes. By setting these attributes with a script, you can zoom and move content around the screen.

DHTML's interactive nature enables authors to let site visitors fine-tune the location and zoom factor for elements on a page. Although they support different versions of DHTML, Microsoft and Netscape jointly subscribe to consistent positioning attributes approved by the World Wide Web Consortium (W3C).

There are five primary positioning attributes. These are *top*, *left*, *width*, *height*, and *zIndex*. The *top* and *left* attributes are pixel offsets from an element's parent. The *width* and *height* variables specify the display area for the

HTML in pixels. The *zIndex* specifies the stacking order for two HTML elements that occupy the same *x* and *y* page coordinates. The element with the most positive *zIndex* stacks on top. The one

ure's effects. The Body section positions a GIF file in the top left corner of the window, with zero width and height. A short five-line script adjusts the image's width and height until it achieves a maximum



With only 12 lines of code (see Code Gallery, next page),
you can create dazzling effects.

with the most negative *zIndex* occupies the bottom of the stack. The element on the top of the stack is visible on the page.

The screenshot above shows an overlaid succession of images that demonstrates a zoom based on dynamic positioning. The image, a company logo, starts out small in the top left corner of the screen. It grows larger and moves further right until it stops at its ultimate size in the lower right corner of the window.

The "Zoom Effect" code segment in the Code Gallery (page 62) shows that a mere 12 lines of code generated the fig-

width of 800 pixels. The *setTimeout* method for the *window* object determines the frequency at which the image dimensions grow. The *window* object's *onload* property causes an event to fire when the window opens, which invokes the procedure to zoom the image.

Dynamic Content

DHTML offers many ways to update, add, or delete text on the fly. Three broad techniques include the *display* property, the *visibility* property, and a collection of four properties and two

Code Gallery

Zoom Effect

```
<HTML><HEADER><SCRIPT>
function go() {
  if (image1.width<800) {
    x=window.setTimeout('go()',100)
    image1.width=image1.width+20
    image1.height=image1.height+10;})
  window.onload = go;
</SCRIPT><BODY>
<IMG id=image1 style=
"position:absolute;left:0;top:0"
height=0;width=0 SRC="../cablogoc1.gif">
</BODY></HEADER></HTML>
```

Magic Hat

```
<HTML><HEAD><STYLE>
  DIV {font-size:36pt; font-weight: bold;
  color:blue; filter:Shadow(color=cyan);height: 25;}
</STYLE><SCRIPT LANGUAGE="JavaScript">
function showFirst() {
  if (document.all.FirstList.style.display == "") {
    {document.all.FirstList.style.display = "none";}
  } else
    document.all.FirstList.style.display = "";
}
function showSecond() {
  if (document.all.SecondText.style.display == "") {
    {document.all.SecondText.style.display = "none";}
  } else
    document.all.SecondText.style.display = "";
}
</SCRIPT><BODY>
<DIV>Why Retain CAB</DIV>
<P onclick="showFirst()">Overview
<UL ID=FirstList STYLE="display:none" >
<LI>Practical Experience
<LI>Outstanding Credentials
<LI>Cost Effective</UL>
<P onclick="showSecond()">Stability</P>
<SPAN ID=SecondText STYLE="display:none">
CAB has over a dozen years experience.</SPAN>
</BODY></HTML>
```

methods that manipulate plain and HTML-formatted text.

InnerText and InnerHTML are read/write properties of DHTML elements. Use these properties to assess an element's content, or paste over it. The difference between them is that the *InnerText* property pertains exclusively to plain text. Use the *InnerHTML* property to insert new elements within an existing tag pair.

OuterText and OuterHTML function like their inner siblings, except that they apply to the HTML element as well as to its content. By replacing either "outer" property with a blank string (""), you delete the element from a page.

A matching pair of methods, *insertAdjacentText* and *insertAdjacentHTML*, enables content authors to add, without replacing, text and HTML to a

page. These methods belong to elements, such as A, DIV, or P. These methods have an argument that permits developers to fine-tune the location of new content relative to an HTML element.

The *visibility* and *display* properties offer an alternative route to dynamic content. You can make content disappear and reappear with either of these properties. The *visibility* property can hide content, but it reserves space on a page for the invisible material. The *display* property works like the *visibility* property, but it doesn't reserve space. Setting *display* to make content visible reflows other content to accommodate the newly visible material.

The "Magic Hat" code segment in the Code Gallery hides and restores text via the *display* attribute. Clicking either

Overview or Stability causes text below each to alternately toggle between visible and invisible states. When the text below Overview becomes visible, the paragraph containing Stability automatically reflows to a new position on the page to accommodate the additional text. Site visitors toggle the visibility of associated text by invoking either the *showFirst* or *showSecond* functions. These functions serve as event handlers for clicks to the first and second paragraph elements, respectively. Setting *display* to *none* makes text invisible, but equating it to " " makes text visible.

Multimedia Effects

DHTML supports multimedia effects through both filters and transitions. Filters can transform text and images. Transitions control how two images exchange positions on the same page, or how one page ends and another starts.

You can fulfill your creative urges with any of 14 filters. The "Magic Hat" code segment illustrates how to apply a shadow filter. The DIV in the Style block designates a cyan shadow for blue text. This DIV style applies to the DIV block at the beginning of the Body section.

There are two classes of transitions: one for content on a single page and another for moving between pages. Within a page, you can invoke reveal or blend transitions. Only reveal transitions support moves between pages. Blend transitions make content fade out and in on a page. Content authors can choose from 24 reveal transitions that are very reminiscent of PowerPoint slide transitions.

Does DHTML Move You?

If you are a site developer, you are probably asking if it's worth learning DHTML. I think most would answer yes. Very small amounts of uncomplicated code—or even no code—can impressively jazz up Web pages.

Now that you know you can, the question is: Will you? The answer boils down to an issue of site envy. DHTML sites will be faster, cooler, and more interactive than non-DHTML sites. Do you care if your clients can get those capabilities only from your competitors? **B**

Rick Dobson, Ph.D., is president of CAB, Inc., a database and Internet development consultancy. You can reach him by sending e-mail to RickD@cabinc.win.net.

Taking Command Just Got Easier



NEW! On Screen Management

The only KVM switch with the power and flexibility to manage the most complex server rooms just got better. Now, not only can you manage hundreds - even thousands - of servers from a single location, but with our new On Screen Management, it's easier than ever. Pop-up menus make it simple to name, configure and select your attached servers on the fly.

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For growing multiuser systems, the AutoBoot Commander 4xP allows up to four users simultaneous access to any attached computer. Add even more users with our expansion options, all with independent access to every computer.

Easy Expansion for your Growing System

Designed for expansion, the 4xP allows you to easily add computers and users as your installation grows. Combine that with our extension capability, and you can locate computers and users as far as 300 feet away from the 4xP unit!



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The 4xP is designed from the ground up to support multiple platforms: Mix and match PC, Sun, SGI, HP 9000, Dec Alpha, RS/6000, and Macs -- control them all with a single set of peripherals.

Whether you run a growing data center or the most demanding server room, the 4xP saves you valuable time, space and money. Who would have thought a command performance could be so easy?



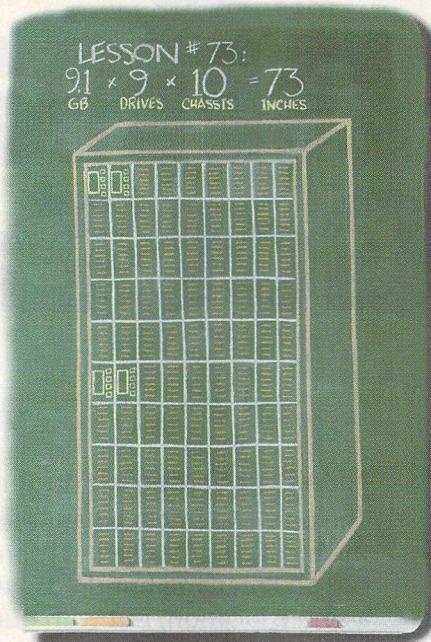
Cybex Computer Products Corporation
4912 Research Drive Huntsville, Alabama 35805 USA
(800) 93CYBEX (29239) • (205) 430-4030 fax
<http://www.cybex.com>



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SEE US AT: COMDEX/Fall '97 November 17-21, Las Vegas, NV, Booth #L4254

Artecon's New RAID Math



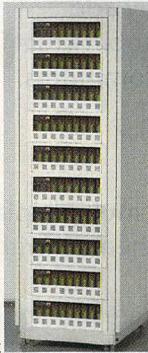
Graduate to the Next Level.

$$9.1 \times 9 \times 10 = 73$$

Other entry-level RAID systems require you to anticipate your future storage needs due to confusing choices in controllers and enclosures. Graduating to the next level becomes difficult, if not impossible. *LynxArray* gives you true scalability by featuring the same controller and enclosure architecture whether you have 9 drives or 90 drives. You can start with a desktop tower using 9.1GB drives, increase your capacity ten times and move to a 73.5" rack with 100% investment protection.

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The Extranet Revolution

Economics and politics are driving entire industries toward extranets, using new technology such as IPsec.

By Scott Mace

There are, arguably, three kinds of revolution: political, economic, and technological. We've lived at the core of the technology revolution for 20 years. It has set in motion economic and political forces that are now reflecting back upon the technology. To be exact, the linking of organizations by networks, the Internet in particular, is revolutionizing the way companies communicate and do business. The phenomenon has many manifestations, but extranets are the most vivid.

Extranets differ from both the Internet and intranets. The Internet remains the network of networks, an agglomeration of agreed-upon protocols, and now applications, that enables any-to-any computer integration. Intranets borrow from the Internet all the important protocols and apps. Extranets, just now taking off, tie intranets together with added security and application integration. In extreme cases, extranets use technology such as public-key encryption to conduct business securely over the public Internet.

Independent financial planners are leveling the playing field with large brokerage houses by using extranets built by Amicus Networks. "Some of our independent broker/dealer sites have links to the clearinghouses and product companies," says Dennis Passovoy, president and CEO of Amicus. For instance, National Financial Service Corporation, a securities clearinghouse, provides quotes, news, and analysis to some of these Web sites, and also let reps enter orders directly online, Passovoy says. Besides building extranets and hosting sites, Amicus acts as a resource for electronic versions of prospectuses upon request. The company also provides commission statements to broker/dealers via e-mail and the Web. The technology exists to enable transactions via digital certificates, Passovoy says.

Consultants are keeping their clients connected through extranets. Since September, Linkage, Inc. (Lexington, MA), a human resources consulting firm, has been communicating with road-traveling clients from companies such as Lucent and Hughes. The Linkage extranet, built by Charter Systems, a provider of multi-vendor enterprise network design and



support services, lets Linkage clients access local and shared files, databases, and e-mail from anywhere on the Internet. The system uses Windows NT servers running Microsoft's IIS and Gateway Services for NetWare, as well as Check Point's Firewall-1. "All Linkage had to provide us was a list of users and access rights they needed," says Frank Lopes, Internet market manager at Charter. The success of this extranet is making Linkage contemplate opening more of its internal Web services, including HR development courses, to those same customers for a fee over the same extranet, according to network administrator Steve Rosonina.

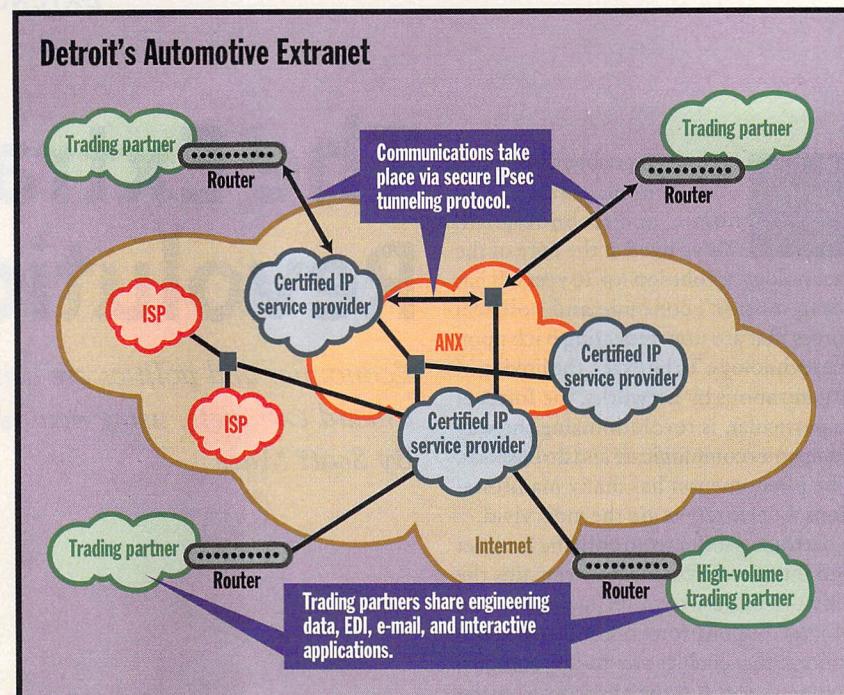
Best Practices

Because extranets are new, best practices for building them are just now emerging. Security, naturally, has been thought out first (see "Defending from the Unthinkable," page 67). But best practices for application integration are still awaiting some technologies, such as object management, that are still maturing.

Those companies that can leverage their existing intranet sales-force applications to extend to suppliers and customers can win big. In early 1995, 95 percent of National Semiconductor's interactive marketing was U.S.-driven. Today, that number is 50 percent, and the chipmaker credits extending its existing applications to its extranet for the company's growth.

From their own intranets, customers can order National Semiconductor sample parts, download data sheets, or buy products from National Semiconductor by giving a credit card number, says Phil Gibson, director of interactive marketing for the company.

The technology National Semi used wasn't cutting-edge—just a few short Perl scripts. "The key requirement is [customers] have to have a live process for building their site, using a database or some type of scripting process," Gibson



The Automotive Network Exchange will be an extranet of 8000 suppliers and, eventually, 20,000 dealers.

says. "We build our site as flat HTML every night, we process that script, write it off to a file, then allow [customers] to pick up that file and run a script on their site." This way, only the approved National Semi part numbers get incorporated on the customer's intranet pages, he says. National Semiconductor's extranet also enables customers and suppliers in Asia and Europe to have a one-hop connection to its Web site by using the Digital Island point of presence in Honolulu.

Different Components

Just as different businesses have different styles, different extranets—whether for information access, collaboration, or transactions—will use different styles of application components. More than 60 percent of large organizations implementing an intranet will require extended secure networks during the next five years, according to Gartner Group. Throughout 1998, security concerns will inhibit the process of extending intranets into extranets.

In some cases, entire industries are poised to take advantage of emerging standards such as IPsec, a set of security protocols that authenticates TCP/IP connections. In late September, developers of the Automotive Network Exchange (ANX),

which includes the Big Three automobile manufacturers, announced successful testing of IPsec among a record number of hardware and software solutions.

ANX is a TCP/IP-based extranet for linking manufacturers with 8000 suppliers and, ultimately, 20,000 dealers. The network will go into production in early 1998.

The range of companies involved in ANX testing is vast, including Bellcore, which is building ANX for the automakers; firewall vendors Check Point Software Technologies, IBM, and Raptor Systems; software vendors including AltaVista Internet Software, Hewlett-Packard, Microsoft, and TimeStep; and hardware vendors such as Ascend and Cisco.

By using electronic data interchange to automate commerce, the ANX automakers estimate they'll shave \$70 off the cost of manufacturing each vehicle, says Tim Hember, president of TimeStep. "The financial and healthcare industries, and the government, are all watching this very closely," he says.

As extranets proliferate, those kinds of bottom-line savings will drive their acceptance and enable extranet products and standards to do even more. **B**

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WHERE TO FIND

Amicus Networks	http://www.aiag.org
Austin, TX	
512-418-8828	
http://www.amicus.com	
Automotive Industry Action Group	
Southfield, MI	
248-358-3570	
Digital Island	
Honolulu, HI	
808-540-4000	
http://www.digisle.net	

Limiting access to extranets is a much more complicated process than limiting access to intranets. This is largely because extranets cannot operate in isolation.

The portion of the intranet intended for external use sits behind its own firewall gateway and is set off from the portion intended for internal consumption by another firewall gateway. The outermost firewall is more permeable, as it is intended mostly to protect the external resources against gross misuse rather than more insidious attacks. After all, the resources within this portion of the intranet are intended to be shared.

The inner firewall, however, protects more-sensitive resources, including production systems and proprietary data resources. It's therefore considerably more restrictive in the packets it allows to pass.

Exposing any more of the organizational intranet to the outside can be quite risky. When the resources to be shared on the extranet must be maintained on more-sensitive internal systems, one approach is to use an object request broker (ORB) that sits outside an inner firewall and accepts—and handles—requests for resources. The ORB responds to requests from the outside by relaying them inward using IIOP and connecting to an ORB on the inside of the intranet. When the interacting objects are designed correctly, outsiders are able to access only the data for which they are authorized (see the figure "Extranet-Enabling Objects" on page 68).

The use of ORBs allows extranet users to have limited access to information and processes that live inside the private portion of an intranet, even though the actual systems through which this information is distributed live outside the physical borders of the extranet.

Authenticating Extranet Users

No matter how the extranet user population is determined, defining this population should be one of your first tasks. It will likely become the most important factor to drive your extranet security, infrastructure, and applications.

The use of simple user IDs and password-access control is sufficient to pro-

Defending from the Unthinkable

Linking intranets requires a combination of security techniques at various levels of the network protocol stack.

By Pete Loshin



tect resources as long as the transmission of password and user IDs is kept private. As more resources are made available through networks, particularly open ones, plaintext transmission of passwords and user IDs becomes less acceptable.

User-authentication tools are necessary, but they are not sufficient to protect valuable resources from unauthorized access. They can be vulnerable to man-in-the-middle eavesdropping, social engineering, and other routes of attack. But these tools can help keep out most casual attackers as well as keep track of resource use.

SecurID ACE

Access control encryption (ACE) is the system used in the Security Dynamics SecurID hardware-token system. SecurID tokens, which are about the size of a credit card (though noticeably thicker), have been used for secured access to organizational networks since the 1980s.

When SecurID ACE users attempt to connect to a protected resource (usually a network, through an ACE server), they are prompted for their user name and a passcode (i.e., the number displayed on the SecurID card, or token, and a personal identification number, or PIN). Then the following sequence of events occurs:

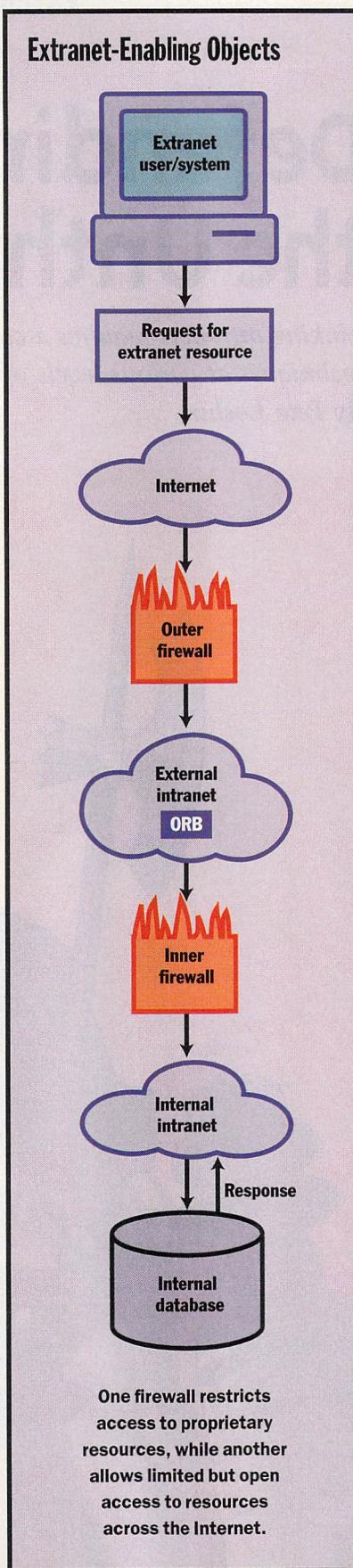
1 The server retrieves the PIN and a seed number associated with the SecurID card assigned to the user name.

2 The server uses another mechanism (using data from previous connections) to attempt to estimate the current clock "drift" associated with the internal time-keeping of the token.

3 The server calculates the correct token passcode, including the PIN, and determines how long that passcode will be accepted as valid authentication.

The passcode is the product of a hashing function that starts with the token's secret key and the current time to generate a time-limited product. The token generates these values continuously, but the server calculates this value when a user attempts to connect to the resource.

The token's secret key, the product of the key, and the current time are never transmitted; rather, a cryptographic hash (or digest) function is applied to the result to produce a much smaller value (but still too large to be susceptible to guessing). If the server comes up with the same



value as the user who is attempting to log in, access is allowed. The result is a two-part authentication:

1 The user enters a correct PIN to indicate knowledge of a shared secret. (The user and the server share this data.)

2 The user enters a correct passcode to indicate possession of the token.

Bellcore S/Key

The risk of using a hardware token for user authentication is that the token can be lost or stolen. Also, if the PIN (which is usually shorter than the typical stand-alone password) can be compromised, a criminal can be authenticated as an authorized user. Bellcore's software-only solution, S/Key, generates one-time passwords based on a password known only to the user and not stored on any system.

S/Key requires only that the server side of the resource be modified. It uses one-time passwords that do not require encryption or any other special treatment through the client. Each time the user logs in, a different password is used; intercepting it would be of little use to anyone.

A sequence of one-time passwords is generated with a one-way hashing function (i.e., a function that modifies input so that it can't be determined simply from the output). S/Key usually uses the MD5 message digest function (sometimes the MD4 function is used) to generate a list of one-time passwords for the user. (These passwords can be either printed out or generated on the user's client system.)

The key to S/Key is that it uses passwords in the reverse order from which they're generated so that the one-way nature of the hashing function can be used to authenticate the user. It works like this:

1 The user enters a secret password in a direct (e.g., at the host console) or secure (e.g., encrypted telnet) connection with the host.

2 The S/Key host software uses that password and an internal, randomly generated key to create a seed value for the password list.

3 The S/Key host hashes the seed value repeatedly, storing only the last value calculated. Typically, the digest function is run 99 times, with the S/Key host storing only the ninety-ninth value, along with

the random value generated to seed the hashing process and the user ID.

4 The user logs in to the S/Key host for the first time and is prompted for the ninety-eighth password (if the one stored on the host is the ninety-ninth value). The S/Key host runs the hashing function on the password that's sent by the user; if the result is the value stored, the user is permitted access.

5 The S/Key host replaces the previously stored password value (the ninety-ninth value) with the password that was just used (the ninety-eighth value). The next time that the user logs in, the ninety-seventh hash value must be used to produce

cols." Very simply, PAP is a two-way handshaking protocol in which the host making the connection (the *peer*) sends a user ID and password pair to the system with which it's trying to establish a connection (the *authenticator*—although not all PPP links require authentication).

PAP is two-way because it uses a simple, two-step process. The peer sends its authentication data, and the authenticator acknowledges approval of the peer. PAP authentication can be used at the start of the PPP link as well as during a PPP session to reauthenticate the link.

Once the PPP link is established, PAP authentication can be carried out over that link. The peer sends a user ID and a password in the clear to the authenticator until

shake protocol because it incorporates three steps to produce a verified link after the link is first initiated (or at any time after the link has been established and verified). Instead of a simple two-step password/approval process, CHAP uses a one-way hashing function in a fashion similar to that used by S/Key. MD5 is specified as a requirement of the protocol, although other functions can be supported. The actual process goes like this:

1 The authenticator sends a challenge message to the peer.

2 The peer calculates a value using a one-way hash function and sends it back to the authenticator.

3 The authenticator can acknowledge authentication if the response matches the expected value.

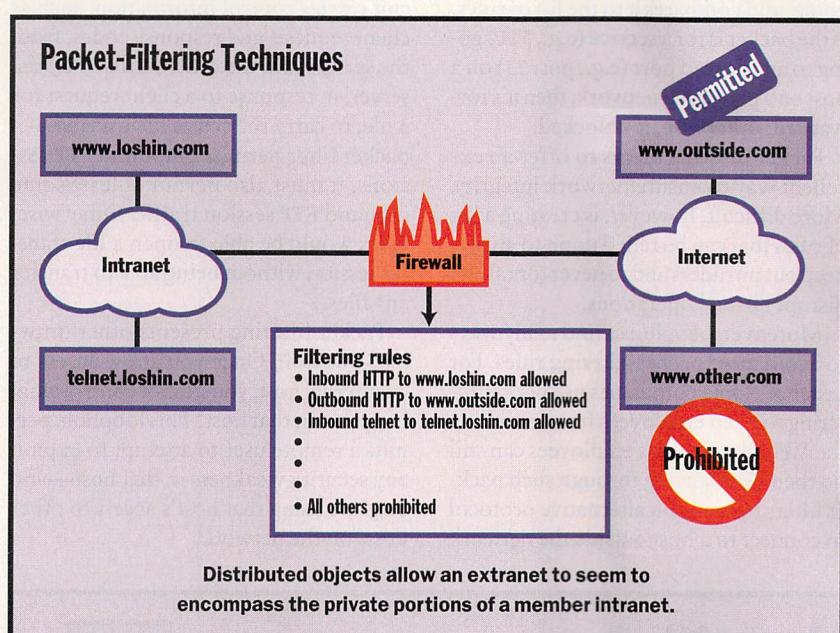
The process can be repeated at any time during the PPP link to ensure the connection has not been taken over or subverted in any way. Unlike PAP, which is driven by the client side, the server controls CHAP reauthentication. CHAP also removes the possibility, inherent in PAP, that an attacker can repeatedly try to log in over the same connection. When the CHAP authentication fails, the server is required to drop the connection. This complicates the task of password-guessing.

Remote Authentication Dial-In User Service

CHAP, though a stronger method than PAP for authenticating dial-up users, is not inherently as scalable a protocol as large organizations might need. Even though it doesn't transmit any secrets across a network, it requires lots of shared secrets to be run through the hash function. Organizations with many dial-up users must maintain very large databases to accommodate them all.

The Remote Authentication Dial-In User Service (RADIUS) protocol, described in RFC 2058, uses a client/server model to securely authenticate and administer remote network connection users and sessions. RADIUS is largely a way to make access control more manageable, and it can support other types of user authentication, including PAP and CHAP.

The RADIUS client/server model uses a network access server (NAS) to manage user connections. Although the NAS functions as a server for providing network



the stored value when the hashing function is run.

Like any security mechanism, S/Key is not 100 percent bulletproof. For example, it can be defeated if a criminal is able to steal the list of passwords or get access to the system storing the user's passwords. However, S/Key is potentially safer than sending reusable passwords in the clear over the Internet.

Password Authentication Protocol

Originally designed as a simple method for a host to authenticate itself to another host while using the Point-to-Point Protocol (PPP), the Password Authentication Protocol (PAP) is described in detail in RFC 1334, "PPP Authentication Proto-

either the authenticator accepts the pair or the connection is terminated. PAP is not secure: Authentication information is transmitted in the clear, and nothing protects against playback attacks or excessive repetition by attackers trying to guess a valid password/user ID pair.

Challenge Handshake Authentication Protocol

Documented in RFC 1994 ("PPP Challenge Handshake Authentication Protocol [CHAP]"), which supersedes RFC 1334, CHAP provides a more secure mechanism for authenticating PPP links. Like PAP, CHAP can be used at the start of a PPP link and then repeated after the link has been established.

CHAP is referred to as a *three-way hand-*

access, it also functions as a client for RADIUS. The NAS is responsible for accepting user connection requests, getting user ID and password information, and passing it securely to the RADIUS server. The RADIUS server returns authentication status (approved or denied), as well as any configuration data required for the NAS to provide services to the end user.

By providing a single point of access while supporting multiple authentication schemes out of multiple systems, RADIUS simplifies the task of securing access to different resources within an internetwork. RADIUS clients and servers communicate securely, using shared secrets for authentication and encryption for transmitting user passwords.

Terminal Access Controller Access-Control System

Terminal Access Controller Access-Control System (TACACS) is a protocol specification, described in RFC 1492, that can administer authentication, authorization, and accounting data for users logging in. TACACS is currently best known as Cisco System's server-based security software protocol. All Cisco router and access-server product families use this protocol.

TACACS employs a centralized server—either a special TACACS database or the Unix password file with TACACS protocol support—to which all authentication, authorization, and accounting data is directed when a user tries to log in. For example, a Unix server supporting TACACS passes requests to the Unix database and returns the accept or reject message to the access server.

TACACS transmits all data in the clear between the user and the server, but a recent update from Cisco, TACACS+, adds a message-digest function to eliminate the plaintext transmission of passwords. TACACS+ also supports multiprotocol log-ins, meaning that a single user ID and password pair can authenticate a user for multiple devices and networks (e.g., an IP network log-in and an IPX network log-in). Finally, TACACS+ can also handle PAP and CHAP authentication.

Protecting Corporate Assets: Packet Filtering

By its nature, the TCP/IP protocol suite makes it relatively easy to set up rules for filtering packets that are traveling in either direction (in or out) through an internetwork router. Every IP datagram includes

data about its destination, source, and contents. Because each IP datagram passing in or out of an internetwork can be forced to go through a single point (the firewall gateway), each one can be checked against a list of rules to determine if it should be allowed to pass.

Packet-filtering rules use the information in the IP datagram to determine what is and is not permitted to pass through the firewall (see the figure "Packet-Filtering Techniques" on page 69). Generally accepted practice is to be strict (prohibiting anything that is not explicitly permitted) rather than to be liberal (permitting anything that is not expressly prohibited).

The firewall gateway doing the filtering checks every packet, incoming and outgoing, and compares it to the list of rules. If the packet is for a service (e.g., FTP) going to an allowed port (e.g., port 23) on a host on a permitted network, then it's forwarded; otherwise, it's blocked.

Packet filtering seems to offer an excellent way to ensure network integrity. More difficult, however, is creating a list of rules that can be relied upon to always keep out intruders and to never (or rarely) disrupt normal operations.

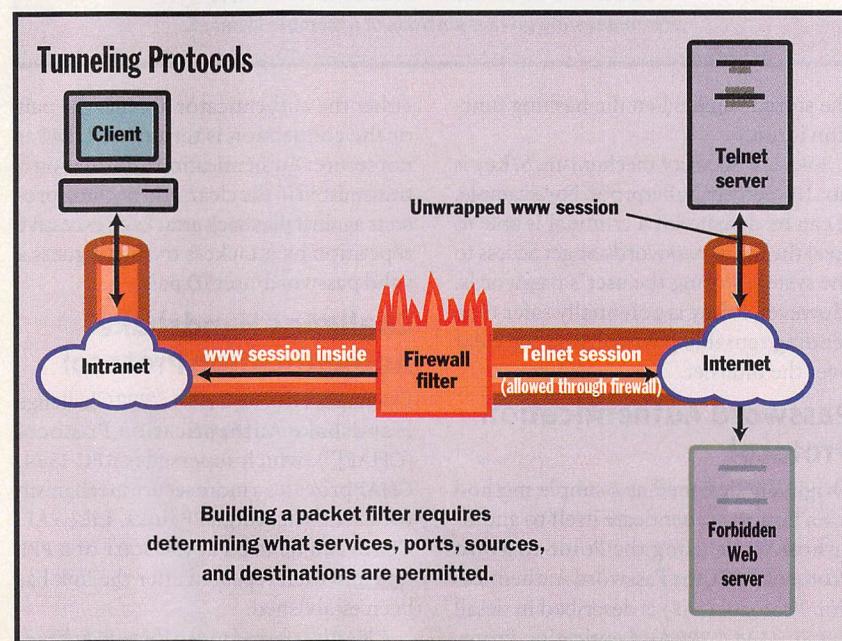
Moreover, people can find many ways to avoid most packet-filtering rules. For instance, some companies use packet filtering to keep employees from accessing the Web. But devious employees can still do their Web surfing through such packet filters by using an alternative protocol to connect to a host outside the network

and then tunneling their Web sessions through that permitted link. A user can tunnel HTTP transfers with a telnet connection through a firewall that prohibits connections to external HTTP servers but permits access to telnet servers (see the figure "Tunneling Protocols" below).

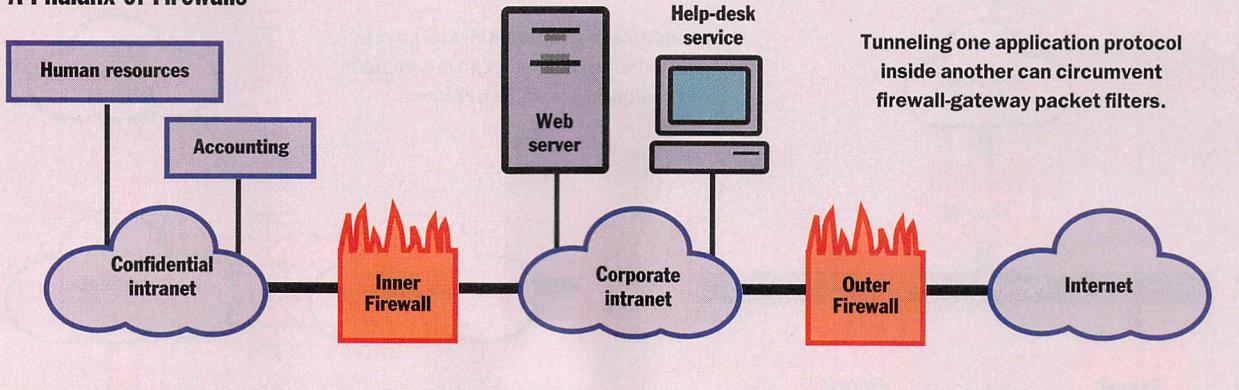
Packet filtering keeps out certain types of casual intruders and might slow down more sophisticated ones; it might also limit use from inside an organization. The way in which TCP/IP application protocols operate makes the filtering of outbound packets as important as filtering inbound packets.

For example, FTP uses two virtual circuits during file transfer: one initiated by the client to connect to the server (this circuit carries control information, such as client requests and response codes, from the server) and the other initiated by the server, in response to a client request for a file, to carry the actual file transfer. If a packet filter permits outbound FTP sessions, it must also permit at least some inbound FTP session traffic. Otherwise, users would be able to open a file transfer session without being able to transfer any files.

Packet filtering presents other drawbacks as well. Once you allow access to an internal host, you cannot control what happens on that host. This loophole permits a remote user to attempt to exploit any security weakness in that host—and possibly using that host's access to other hosts on the network.



A Phalanx of Firewalls



Also, packet filters use the information stored in IP datagram headers, which means that attackers can do *IP spoofing*—counterfeiting the source IP address of the datagram, making the gateway believe it comes from an authorized host.

Circuit Gateway

Another approach to protecting internal hosts from attack is to have the firewall system act as an intermediary for all application exchanges. In other words, internal hosts pass all session requests through the firewall, which forwards them to the remote server as if they were coming directly from the firewall. The remote server then responds to the request by replying directly to the firewall, which relays the response to the internal host. Both the internal and external systems connect directly to the firewall, which relays all messages between the two.

Circuit-level gateways act to eliminate access to unauthorized servers on the protected network. This security measure provides a certain amount of protection from attacks that originate from within an organization. Server software can be configured to listen to a nonstandard transport layer (where circuits are created in TCP/IP networking) port, allowing access by unauthorized users from outside the protected network, even if packet filtering is turned on. Circuit gateways can eliminate this risk because they deny all unsolicited incoming requests.

On the downside, circuit gateways often require that systems inside the gateway use special versions of TCP/IP client application software to support the indirect connection with external hosts through the circuit gateway. Consequently, all users within an organization wish-

ing to go through the firewall to access services outside the firewall need to have special copies of the client application software; standard clients are denied access through the firewall. And, of course, because no inbound client requests are permitted, circuit gateways support a limited level of service.

Application Proxies

Whereas circuit gateways use special software to provide the interface between the application client inside the firewall and the application server outside the firewall, an application gateway provides the same service seamlessly. The firewall acts as a proxy for the client when a service is requested and passes responses from the server back through to the client.

An advantage of application gateways is that you can configure them to pass external requests in to approved servers. This technique is possible because all requests to open well-known ports are funneled through a single point: the application gateway.

Because they're involved directly in every application interchange between clients and servers inside and outside the firewall, application gateways can do very detailed logging of all those connections—and of all attempted connections. Logging failed attempts to break into systems on an intranet can be invaluable in tracking down the source of the attacks. And, of course, when combined with network-administrator notification systems, firewall gateways can alert intranet managers to an attack in progress.

Application gateways mediate all client and server connections to systems outside the intranet, a task that can be very computer intensive. One potential problem is

that application gateways can become a performance bottleneck, particularly as the number of simultaneous sessions increases.

Nested Security Zones

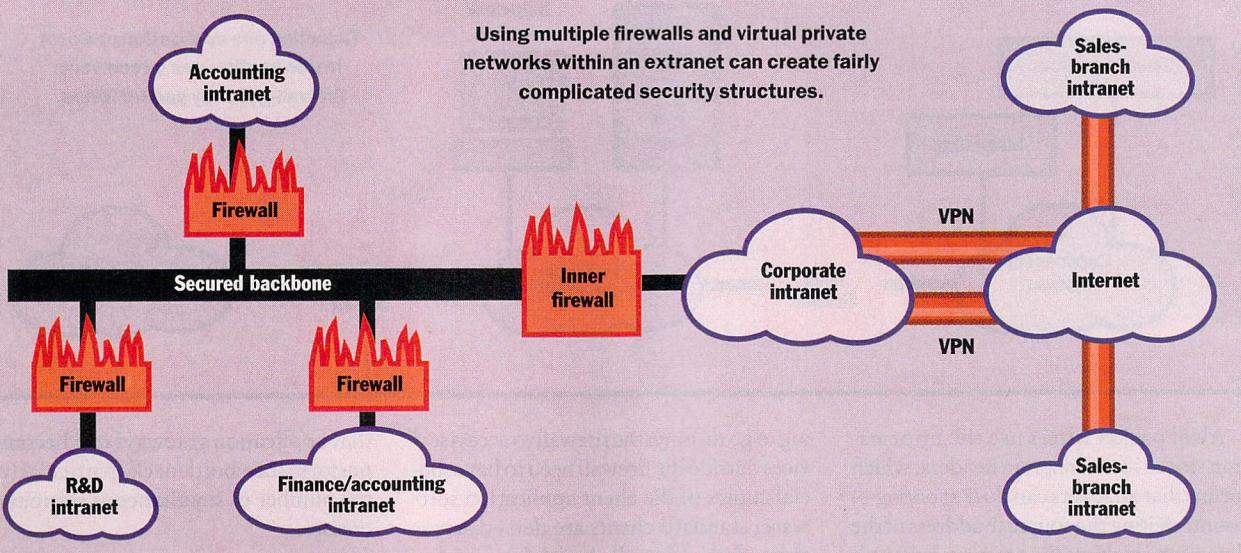
The purpose of traditional firewalls is very simple: to separate an intranet from the Internet. Extranets, however, are often designed to provide some degree of permeability to access via the Internet. Using multiple firewall systems within an organizational extranet allows the organization to selectively open only part of its internetwork to the Internet. The figure "A Phalanx of Firewalls" above shows a simple example of how nesting firewalls can produce two security zones—one for internal, proprietary systems and the other for open, shared extranet systems.

In general, as you move inward into an internetwork across firewalls, the level of security should be constant or increase, not decrease. In other words, the outer firewalls should be stronger than the inner ones. When stronger firewalls are used for the outermost perimeter, intruders able to pierce that perimeter will almost certainly be able to easily bypass internal firewalls. On the other hand, when firewalls increase in strength as they move inward to more valuable resources, intruders face greater obstacles to access as they attempt to attack those resources.

By properly nesting firewalls and combining them with virtual private networks (VPNs), it's possible to partition internets into security zones within the extranet. Internal peer networks and intranets can maintain interconnectivity within security zones while restricting access to outsiders (see the figure "Mixing and Matching" on page 72).

continued

Mixing and Matching



No security infrastructure can reliably and securely operate by itself. Until true AI—capable of making reasoned decisions affecting all extranet users—is developed, an experienced human should be included in the decision loop. Network auditing is a requirement, however, to allow automated systems to monitor all extranet access, flag any suspicious activity, and then notify the human network manager appropriately.

Weighing Caution Against Performance

The extranet manager is responsible for determining what to audit, what to record, and what type of event should trigger a notification (and what type of notification the event deserves, such as e-mail, a wireless page, or a weekly status report). Being too cautious can be costly in time wasted on false alarms, hardware required to store excessively detailed audit data, and time spent on keeping track of all the audit information. On the other hand, a lack of caution can allow intruders to slip in unnoticed.

Deciding how to audit extranet access and what to audit are important decisions that should be made with the informed participation of all responsible parties—and probably a security consultant. As with any other aspect of extranet security, all parties should be aware of the cost of implementation and the risk related to forgoing the security feature. The final decision should balance both.

Securing Open Channels

The TCP/IP protocol suite is a set of open standards designed for interoperability. This openness can pose a security risk because TCP/IP data is generally transmitted in the clear, often across public networks, and usually across networks about which the source and destination systems have no knowledge.

The remainder of this article introduces some of the security and encryption protocols that are currently implemented or in development for use at the application, transport, and network layers.

Application-Layer Security

Virtually any application that requires a password for access could be said to provide some degree of application-layer security, but fewer applications actually use that password to secure the data that's passed back and forth between client and server. This section introduces some of the more popular applications that implement security of this type at the application layer.

Secure Electronic Transaction

MasterCard International and Visa International, after a great deal of work and some apparent disagreement, released a specification for the Secure Electronic Transaction (SET) protocol in 1996. Developed with input from GTE, IBM, Microsoft, Netscape, SAIC, Terisa, and Verisign,

and eventually supported by American Express and other credit-card issuers, the SET protocol defines how transaction data flows among card users, merchants, and banks; it also defines the security functions (i.e., digital signatures, hashes, and encryption) that must support these transactions.

Major card issuers have been urging their cardholders not to use their cards for Internet transactions unless they also use SET. (Some issuers have also supported the CyberCash service.) Most organizations providing Internet-commerce services and software have committed to supporting SET when it's completely specified, with widespread deployment of SET-enabled commerce applications likely to occur by the end of this year.

Secure HTTP

The Hypertext Transfer Protocol (HTTP), upon which the Web is built, does not include any mechanisms for security. The Secure HTTP (S-HTTP) protocol was developed as an extension to HTTP and is documented in Internet Engineering Task Force (IETF) working group documents.

S-HTTP described a mechanism for using standard cryptographic tools to encrypt HTTP data transfers. Although S-HTTP was widely implemented in Web-server software by 1995, few browsers that implemented this protocol were available. The popularity of Netscape's secure browser and server offerings has largely eclipsed S-HTTP.

continued

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Pretty Good Privacy

Pretty Good Privacy (PGP) is not, strictly speaking, a network application. PGP is a program that can be used to create and verify digital signatures and to encrypt, decrypt, and compress data.

It's widely used to encrypt, decrypt, sign, or verify data that has been or is about to be transmitted across an open network, and it has gained considerable popularity. The PGP file formats are described in RFC 1991, and PGP has often been grafted onto other network applications to provide security.

Secure MIME

MIME, which stands for Multipurpose Internet Mail Extensions, is documented in RFC 1521. It defines an orderly method of attaching files for transmission over the Internet. The Secure MIME (S/MIME) specification adds a hierarchical approach to security, providing a formal definition of users and certifiers and making it more scalable to large organizations.

MIME Object Security Services

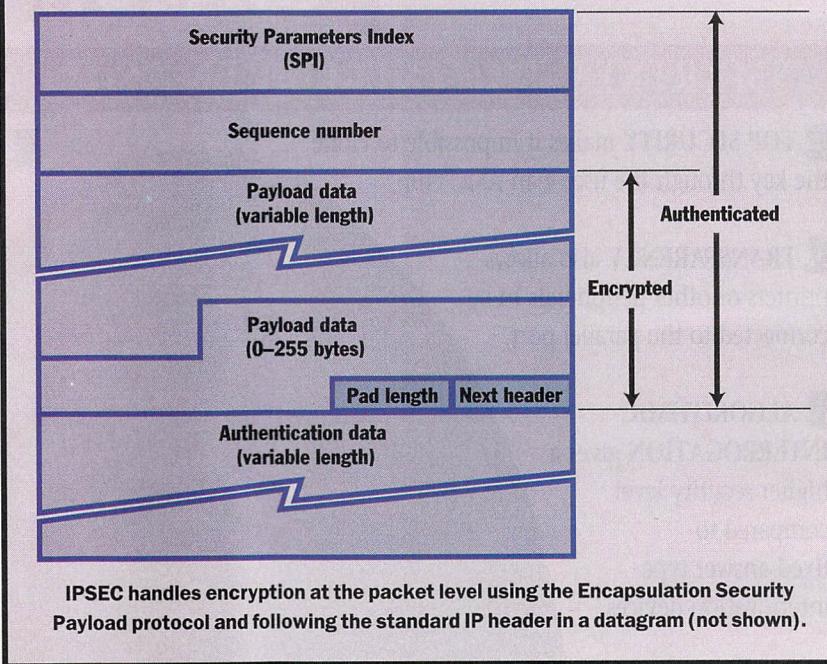
Another approach to security with MIME is described in RFC 1848. MIME Object Security Services (MOSS) describes how encryption and digital signatures can be added to MIME objects.

CyberCash

The CyberCash Internet commerce application protocol, described in RFC 1898, has been used since 1995 to process credit-card transactions on the Internet. This protocol is notable because it's implemented at the application layer, encrypting and digitally signing credit-card transaction data so that consumers are notified of their transaction approval (or denial) and merchants are able to complete the transaction within seconds.

Transactions are encrypted from the consumer to the card processor, and all transactions and approvals are digitally

How IPSEC Embeds Encryption in Packets



signed. The CyberCash protocol is similar to the SET specification.

Transport Layer Security

With no widely accepted secure protocol for Web commerce, and with few prospects for early completion of the S-HTTP project, Netscape seized on the opportunity and developed its own security protocol, which the company deployed widely in freely distributed browsers as well as in a line of commercial Web servers. Later released for use in standards development, the Secure Sockets Layer (SSL) operated between the transport layer and the application layer, offering a protocol for negotiating a secure connection between client and server.

By using the transport layer, SSL can encrypt the application data stream between any application clients and servers, not just Web clients and servers, as long as they interface properly with TCP through

SSL. Although SSL and its apparent failings have received a lot of attention, most of the deficiencies have been related either to problems with the way in which SSL was implemented or to the length of the keys used. To date, SSL continues to be a reasonable—and widely implemented—mechanism for encrypting streams of data from applications.

Network Layer Security

The IETF formed the IP Security Protocol working group (IPSEC) to develop methods to protect IP client protocols at the network layer. As of early 1997, the group's efforts had produced IP Header Authentication (HA, described in RFC 1826) and the IP Encapsulating Security Protocol (ESP, described in RFC 1827).

Some other protocols described by this working group are Simple Key Management for Internet Protocols (SKIP), Internet Security Association and Key Management Protocol (ISAKMP), and Internet Key Management Protocol (IKMP). These are described in draft documents available from the IETF Web site. B

WHERE TO FIND

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<http://www.bellcore.com/SECURITY/skeywp.html>

Internet Engineering Task Force
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MasterCard International
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Netscape Communications
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*Pete Loshin is a technical editor for BYTE reviews. You can reach him at pete@loshin.com. Excerpts from his book *Extranet Design and Implementation* (Sybex, 1997; ISBN 0-7821-2091-1) are printed by permission of Sybex, Inc.*

Now that extranets have a name, products and services for developing, enabling, and hosting them will appear in increasing numbers. With new energies focused on an emerging extranet market, the growth rate for this category will continue to accelerate.

Let's look at four categories of products: extranet services, extranet hosting and network connectivity, extranet development tools, and virtual private networks. In fact, there is considerable overlap among these categories. Some extranet hosting companies also develop software tools that support a customer's extranet, and some also provide development services to design and manage a customer's extranet presence.

Extranet Services

The lines between categories of extranet products and services are blurred, if not practically nonexistent. A number of consultants and site developers have "products" that have interesting names but are not offered as tools that end users can purchase or use.

For example, Click Interactive has what it calls the Extrascape Suite, a set of proprietary tools that Click uses to create extranet sites for its clients. Extrascape Suite enables Click to build custom applications that support transaction processing. But this toolkit is proprietary to Click, which designs the extranets.

Another example is InterBusiness Partner, offered by GE Information Services (GEIS). GEIS does everything from site design and administration to extranet hosting. InterBusiness Partner "is a turnkey package that includes [Netscape] SuiteSpot Server applications, with additional administrative and user-interface-type glue that [GEIS] puts on," says Barry Jillett, InterBusiness Partner product manager. InterBusiness Partner is sold as a basic offering, and it provides the ability to put up access-controlled Web pages, a BBS, and a mail server, Jillett explains.

Although GEIS offers the turnkey package, Jillett stresses that the focus at GEIS is on systems integration. GEIS consultants assist the client with defining their needs and interfacing with Netscape, and they

Extranets at Your Service

Whether you leave the development to others or do it yourself, the options are expanding.

By Mark Brownstein



can manage the linkage of the extranet site to a customer's Internet service provider (ISP). GEIS also offers hosting services.

Megasoft offers Megasoft Online, which implements such proprietary elements as Megasoft Web Transporter to handle security, accounting, and tracking of software installation and configuration. Megasoft does not offer its product as a development package, instead providing planning, development, and support services.

GTE Internetworking, which acquired BBN, a consulting and development service with roots going back to the Arpanet, offers extranet services ranging from design and development to extranet hosting. In December, GTE Internetworking will begin offering a development package (unnamed at press time).

The new package will include Oracle's database server and other software, says Kate Dodson, director of Web applications at GTE Internetworking. "Although the package can be sold stand-alone," Dodson notes, "we anticipate that, due to the specific requirements across business and industries, development is done [by GTE Internetworking]. The customer can purchase the software and integrate it themselves but would negotiate a separate support contract."

In addition to the new platform, GTE Internetworking provides development, management, and hosting services. The services offered by GTE, as well as those offered by GEIS, are targeted at Fortune 2000 companies. Typically, these services

are relatively high-ticket items, costing in the area of \$50,000 and up.

Hosting and Connecting

Hosting and ISP connections to an Internet backbone are offered by various providers. Companies that have already developed Internet and intranet sites hosted by an ISP can retain their providers, in most cases. However, the increased messaging and traffic demands that can be placed on an ISP as a result of opening the extranet to multiple groups of users could become problematic for some smaller providers.

Most developers will be able to design systems that allow companies having their own direct connections to the Internet to do their own site hosting. Keeping extranet hosting as an in-house activity may provide a feeling of extra security, since management of the "demilitarized zone" and appropriate firewalls remains under the control of the company's Web-master or other specialist. However, such companies as GEIS, GTE Internetworking, Evergreen, and others specializing in Internet commerce and site hosting could prove to be cost-effective, in addition to being more secure.

A number of large companies, as well as those already mentioned, provide hosting and interconnection services. These include IBM Global Network, SprintNet, and Worldcom/UNet. MCI Systemhouse, too, provides hosting and Web site services.

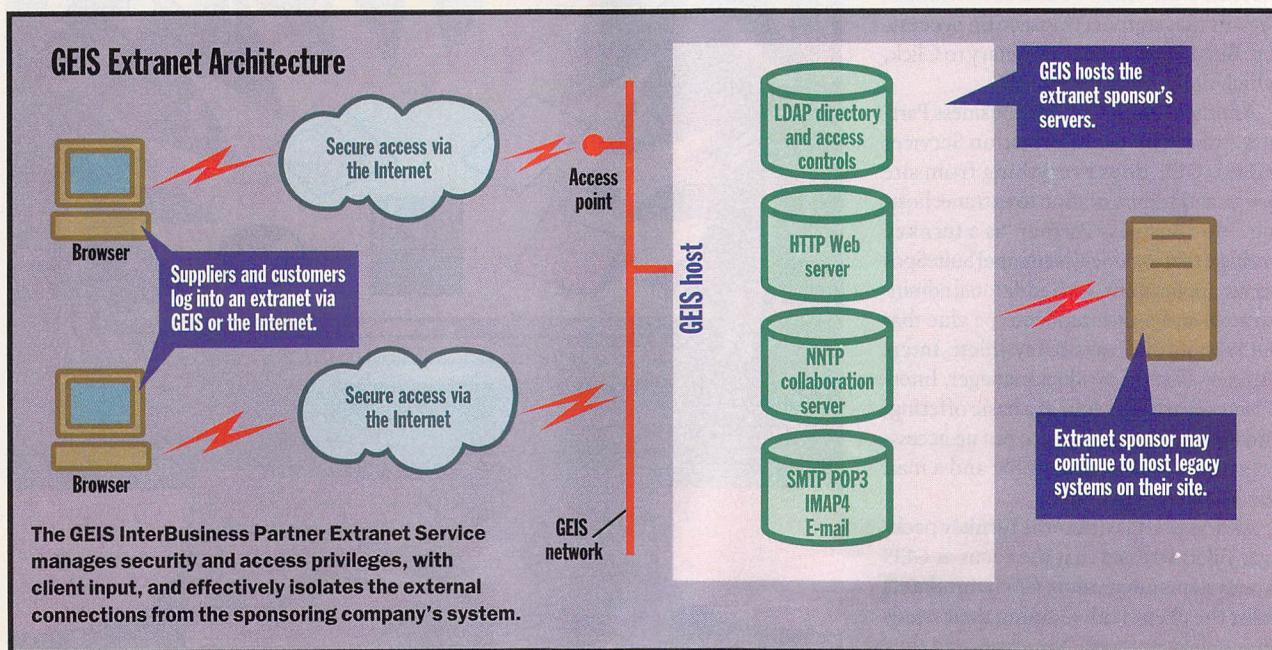
InfoTEST International is an alliance of

U.S. corporations and government entities set up to demonstrate and evaluate extranet architectures and implementations. There are two kinds of extranets, according to Troy Eid, InfoTEST's chief operating officer. "So-called proprietary extranets use their own backbone and connection, and they provide encryption," Eid explains. "The benefits they provide are a higher level of security and guaranteed levels of quality and class of service." Eid cites Worldcom/UUnet as an example of a private, or proprietary, provider. One of the major disadvantages is that all the participants on the proprietary extranet must be able to connect through the proprietary service.

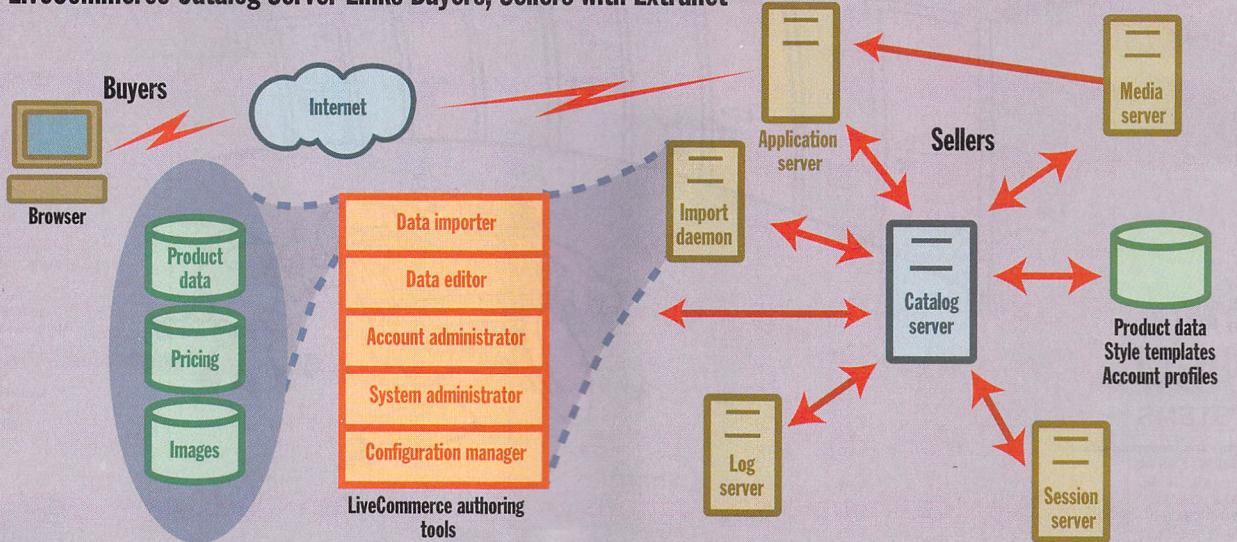
The other type of extranet uses the public Internet infrastructure. "The advantage is that you can use the public Internet for connectivity, but using the public Internet lacks the class of service and can have some security problems," Eid says.

Development Tools

Extranet development tools have evolved from simple e-commerce to more sophisticated catalog servers that present customized content, product lines, pricing, and branding specific to each customer. Open Market's LiveCommerce Server for Windows NT tackles a whole range of catalog-server requirements. It enables developers to design tailored presentations of catalogs for specific customers or customer groups. Pricing for LiveCommerce starts at \$45,000 for one development



LiveCommerce Catalog Server Links Buyers, Sellers with Extranet



Everything that makes up a LiveCommerce catalog's "style" is stored in templates separate from product data, so developers can change the look and feel of a catalog without changing the data (or vice versa).

license, one production license, all underlying database licenses, and unlimited authoring seats.

In addition, Open Market has built a network of "commerce service providers" around its OM-SecureLink, which connects existing Web content to corporate databases. These service providers include BBN Planet, British Telecom, iSTAR Internet, MCI, and UUnet PIPEX.

Differential offers FileDrive EX, a secure file server designed for extranets. FileDrive EX implements a technology that the company calls Extranet Object

Network (EON) architecture. This architecture supports demilitarized zones that open firewalls and allow multiple users to be logged onto the extranet without compromising the security of any party in the zone. The EON architecture is a multiplatform design that supports third-party plug-ins and will be available for many operating system platforms. Support for many common APIs and programming languages is included in the EON architecture, the company says.

Virtual Private Networks

Virtual private networks (VPNs) are another technology that could reasonably be described as components of an extranet. VPNs connect remote computers to a company's central network, creating, in effect, a wide-area network using the Internet or a private network as the conduit.

Some VPNs use Point-to-Point Tunneling Protocol (PPTP), developed by Microsoft, 3Com, and other companies to embed data into the standard IP packet. This data, which is usually encrypted, is disassembled from the packet, decrypted, and passed securely between the remote user and the central network.

Network TeleSystems' NTS TunnelBuilder is a secure remote-access client that creates encrypted tunnels using PPTP. The TunnelBuilder PPTP client, available for Windows 95, 3.1, 3.11, or the Macintosh OS, connects to PPTP servers and can

securely access corporate resources.

ExtendNet VPN, from Extended Systems, is a server that consolidates remote-access lines into existing Internet channels. Remote clients running Windows 95 or Windows NT can connect to the corporate server using PPTP. It should be noted that security protocols will be implemented in routers and switches, which will encrypt and decrypt data packets passing through.

Undoubtedly, PPTP servers and client software will become an important part of extranet software offerings. Ultimately, PPTP will become ISP-transparent, with "standard" IP packets containing tunneling data passed transparently through public and private IP backbones. Standards for implementation of the router-based security have not yet been finalized. Bay Networks and Cisco Systems, for example, are proposing two different, and incompatible, methods.

Although extranets might be more of an extension of existing Internet and intranet capabilities, selecting products or services will undoubtedly involve a look at the constantly changing options so that you can choose wisely. B

Mark Brownstein (Northridge, CA) is a writer/editor specializing in high technology. He has written five books and has been editor of three magazines. You can reach him by sending e-mail to Mark@brownstein.com.

WHERE TO FIND

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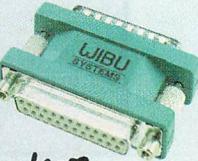
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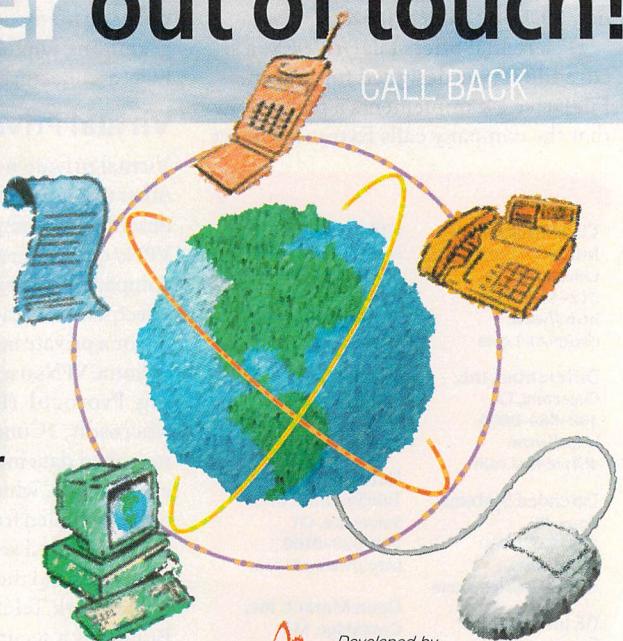
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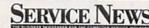


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BEYOND PENTIUM II

Here's the first detailed look at the new breakthrough microprocessor architecture from Intel and Hewlett-Packard—and what it will mean for developers and users.

By Tom R. Halfhill

For Intel and Hewlett-Packard, the year 2000 isn't a problem—it's an opportunity. In late 1999, Intel plans to ship Merced, the first microprocessor based on a next-generation architecture jointly conceived by the two companies. Although this 64-bit architecture builds on years of research at Intel, HP, other companies, and universities, it is radically different from anything ever attempted on a mass-market scale. Whether it succeeds or fails, one thing is certain: It will change the computer industry forever.

Known as Intel Architecture-64 (IA-64), the new definition breaks clean with the past in a startling fashion. IA-64 is emphatically not a 64-bit extension of Intel's 32-bit x86 architecture. Nor is it an adaptation of HP's 64-bit PA-RISC architecture. IA-64 is something completely different—a forward-looking architecture that uses long instruction words (LIW), instruction predication, branch elimination, speculative loading, and other advanced techniques to extract more parallelism from program code.

Although Intel and HP promise backward compatibility with today's x86 and PA-RISC software, they're still withholding those details. Compatibility will not be trivial because IA-64 goes far beyond the 32-bit extensions that Intel added to the x86 in 1985, as well as the 64-bit extensions that HP added to PA-RISC in 1996. It's worth remembering that the x86's much

less radical transition from 16 to 32 bits has so far taken 12 years and still is not complete.

The migration to IA-64 won't concern most users in the short term, however, because Intel says it's designing Merced for high-end servers and workstations. Merced is not for mainstream PCs. In fact, Intel says IA-64 won't replace the x86 "for the foreseeable future." It's likely that Intel (and other x86 vendors) will continue to introduce new generations of x86 chips for years to come.

Superwide CPUs

Before plunging neck-deep into the technical innards of IA-64, it is critical to understand why Intel and HP are gambling their futures on such sweeping changes. It comes down to this: Intel and HP think CISC and RISC are running out of gas.

Intel's x86 is an ancient CISC architecture that dates back to 1978. In those days, CPUs were scalar devices (able to execute only one instruction at a time) with little or no pipelining. Chips had tens of thousands of transistors. HP's PA-RISC architecture dates back to 1986, when superscalar (multiple-instruction) pipelines were just starting to sprout and chips had hundreds of thousands of transistors. In the late 1990s, leading-edge processors have millions of transistors.

By the time Merced makes its debut, Intel will be rolling out the next generation of process technology beyond today's

x86

IA-64: What's Different

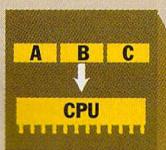
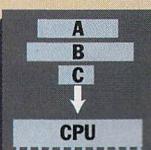
IA-64

Uses complex, variable-length instructions processed one at a time.

Reorders and optimizes the instruction stream at run time.

Tries to predict which way branches will fork, and speculatively executes instructions along the predicted path.

Loads data from memory only when needed, and tries to find the data in the caches first.



Uses simpler, fixed-length instructions bundled together in groups of three.

Reorders and optimizes the instruction stream at compile time.

Whenever practical, speculatively executes instructions along both paths of a branch and then discards the results it doesn't need.

Speculatively loads data before it's needed, and still tries to find the data in the caches first.

latest 0.25-micron process—0.18-micron. Even the first IA-64 chips will have tens of millions of transistors. Future generations will have hundreds of millions.

CPU architects are eager to put those transistors to work. They want to design chips with many more functional units—that execute more instructions in parallel—but they're hitting a wall of complexity. As they add more units to make the CPU "wider," they must also add more control circuitry to dispatch those instructions to the units. Today's best CPUs can't retire more than four instructions per clock and already waste too much silicon on this purely bookkeeping logic.

At the same time, the sequential nature of program code and the frequency of branches make it increasingly difficult to dispatch instructions in parallel. Today's CPUs devote enormous amounts of logic to minimizing branch penalties and to extracting as much hidden parallelism as possible from the code. CPUs reorder instructions on the fly, predict where branches will jump, and speculatively execute instructions beyond the branches. If the CPU guesses wrong, it must discard the speculative results, flush the pipelines, and reload the correct instructions—paying a heavy penalty in lost cycles. CPUs that theoretically can retire four instructions per clock actually average less than two per clock.

To compound these problems, memory chips haven't come close to matching the soaring clock speeds of CPUs. When Intel

designed the first x86 chip, CPUs could fetch data from memory as fast as they could process the data. Today, CPUs spend hundreds of clock cycles waiting for data to arrive from memory, despite having large, fast caches.

Intel and HP are addressing all these problems. Here's what they divulged in two lengthy interviews with BYTE:

- The new IA-64 format packs three instructions into a single 128-bit-long bundle for faster processing. Usually this is called LIW encoding, but Intel shuns that label, saying LIW has "negative connotations." For the same reason, Intel does not like to describe the individual instructions as "RISC-like," even though they are fixed-length and presumably optimized for single-cycle execution in a core that doesn't need microcode. Intel calls its new LIW technology Explicitly Parallel Instruction Computing, or EPIC.

At any rate, IA-64 is nothing like the x86. An x86 instruction is a single unit that can vary from 8 to 108 bits long, and the CPU must tediously decode each instruction while scanning for the instruction boundaries. (See the figure "IA-64 Instruction Format," page 82.)

- Each 128-bit IA-64 bundle contains a template of several bits—placed there by the compiler—that explicitly tells the CPU which instructions it can execute in parallel. No longer must the CPU hurriedly analyze the instruction stream at run time to uncover hidden parallelism. Instead, the compiler identifies the

parallelism and binds this information into the machine code.

Each instruction contains three 7-bit general-purpose register (GPR) fields, and the fields are specific to integer and floating-point (FP) instructions. That means IA-64 processors will have 128 integer-type GPRs and 128 FP registers. All are programmer-visible, random-access registers. Compare that to the constipated x86, which has eight integer GPRs and an eight-entry FP stack. IA-64 processors can be much wider and will stall less often due to false dependencies (e.g., shortages of registers).

- IA-64 compilers will use a technique called *predication* to remove the penalties caused by mispredicted branches and the need to jump over blocks of code beyond branches. When the CPU encounters a predicated branch at run time, it will begin executing the code along all destinations of the branch, exploiting as much parallelism as possible. When the CPU discovers the actual branch outcome, it stores the valid results and discards the others.

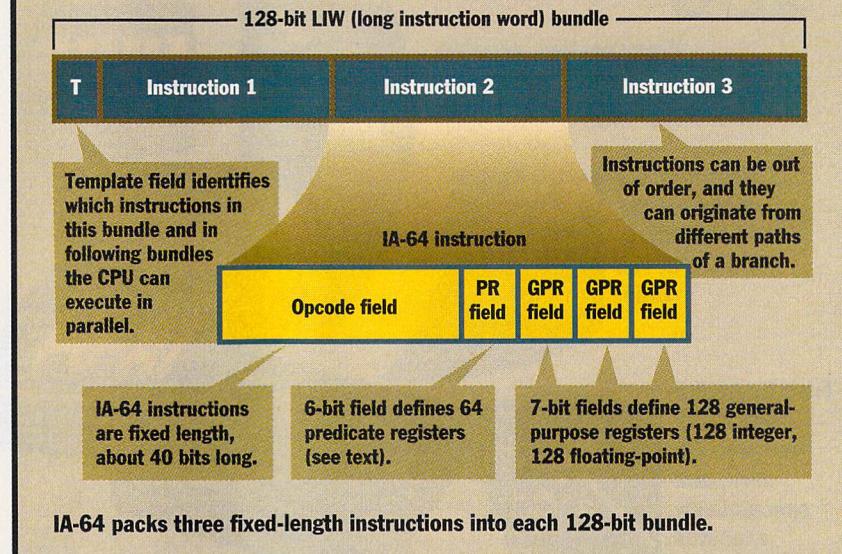
- IA-64 compilers will scan the source code to find upcoming loads from memory, then will add a speculative load instruction and a speculative check instruction. At run time, the first instruction loads the data from memory before the program needs it. The second instruction verifies the load before letting the program use the data. Speculative loading helps hide the long latencies of memory accesses and helps increase parallelism.

One implication of IA-64 is that compilers will have to be a lot smarter about the microarchitectures of the CPUs they target. Existing chips—even RISC chips with optimized compilers—do much more optimizing at run time than IA-64 chips will. IA-64 transfers the job of optimizing the instruction stream to the compiler. Successive generations of IA-64 processors will run older IA-64 software, but the software might not run at top speed until it's recompiled. In the IA-64 age, developers might have to ship multiple binaries to get the best performance on a broad installed base of IA-64 systems.

Another impact will be code expansion. IA-64 instructions are longer than 32-bit RISC instructions—about 40 bits each. Just by recompiling existing code, developers will almost certainly see their programs grow larger. And those programs will probably take longer to compile because IA-64 demands a lot more work from the

IA-64 Instruction Format

Note: Exact arrangement of fields within bundles and instructions is unknown. Intel and HP might divulge additional fields later.



compiler, as we'll see in a moment. Intel and HP say they're already working with tool vendors to help them revise their products.

Disappearing Branches

Predication is a prime example of the new burden shifted onto compilers. This technique is central to IA-64's branch elimination and parallel instruction scheduling.

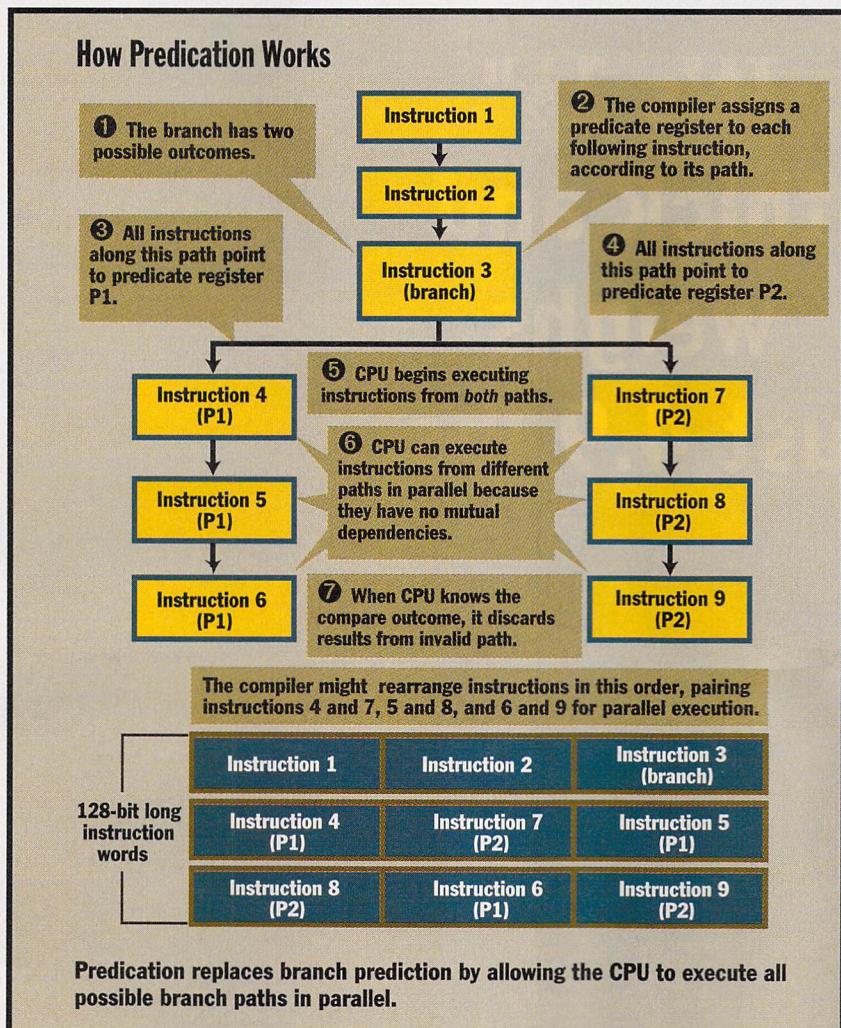
Normally, a compiler turns a source-code branch statement (such as IF-THEN-ELSE) into alternate blocks of machine code arranged in a sequential stream. Depending on the outcome of the branch, the CPU will execute one of those *basic blocks* by jumping over the others. Modern CPUs try to predict the outcome and speculatively execute the target block, paying a heavy penalty in lost cycles if they mispredict. The basic blocks are small, often two or three instructions, and branches occur about every six instructions. The sequential, choppy nature of this code makes parallel execution difficult.

When an IA-64 compiler finds a branch statement in the source code, it analyzes the branch to see if it's a candidate for predication. Compilers can't predicate every branch: Dynamic method calls that the CPU won't discover until run time are one obvious exception. In other cases, predication might cost more cycles than it saves. Compilers will have to be clever about this.

If the compiler determines that predication makes sense, it marks all the instructions that represent each path of the branch with a unique identifier called a *predicate*. For example, the compiler might tag each instruction that follows the TRUE condition with the predicate P1; and it might tag each instruction that follows the FALSE condition with the predicate P2. IA-64 defines a 6-bit field in each instruction to store this predicate. Thus, there are 64 unique predicates available at one time. Any number of instructions that share a particular branch path will share the same predicate.

After tagging the instructions with predicates, the compiler determines which instructions the CPU can execute in parallel. Again, this requires the compiler to know a lot about the CPU's microarchitecture, because different IA-64 chips will have different numbers and types of functional units. Also, of course, the compiler must watch out for data dependencies—an operation that needs the result of a previous operation cannot execute in parallel with that operation. But the compiler will almost always find some parallelism by pairing instructions from different branch outcomes because they represent independent paths through the program.

Now the compiler can start assembling the machine-code instructions into 128-bit bundles of three instructions each. The bundle's template field not only identifies



which instructions in the bundle can execute independently but also which instructions in the following bundles are independent. So if the compiler finds 16 instructions that have no mutual dependencies, it could package them into six different bundles (three in each of the first five bundles, and one in the sixth) and flag them in the templates.

The bundled instructions don't have to be in their original program order, and they can represent entirely different paths of a branch. Also, the compiler can mix dependent and independent instructions together in a bundle, because the template keeps track of which is which. Unlike some previous very-long instruction word (VLIW) architectures, IA-64 does not insert null-operation instructions (NOPs) to fill slots in the bundles.

At run time, the CPU scans the templates, picks out the instructions that do not have mutual dependencies, and then dispatches them in parallel to the func-

tional units. The CPU then schedules instructions that are dependent according to their requirements.

When the CPU finds a predicated branch, it doesn't try to predict which way the branch will fork, and it doesn't jump over blocks of code to speculatively execute a predicted path. Instead, the CPU begins executing the code for every possible branch outcome. In effect, there is no branch at the machine level. There is just one unbroken stream of code that the compiler has rearranged in the most parallel order.

At some point, of course, the CPU will eventually evaluate the compare operation that corresponds to the IF-THEN statement. Now the CPU knows the outcome. Let's say the condition is TRUE, so the valid path is predicate P1, not P2. The 6-bit predicate field in each IA-64 instruction refers to a set of 64 predicate registers (P0-P63), and each register is 1 bit wide. The CPU will store a 1 in predicate register P1 to repre-

sent TRUE, and it will store a 0 in predicate register P2 to represent FALSE.

By this time, the CPU has probably executed some instructions from both possible paths. But it hasn't stored the results yet. Before taking that final step, the CPU checks each instruction's predicate register. If the register contains a 1, the instruction is valid, so the CPU retires the instruction and stores the result. If the register contains a 0, the instruction is invalid, so the CPU discards the result. (See the figure "How Predication Works," at left.)

Predication effectively removes the negative impact of a branch at the machine level while preserving branch behavior. Again, it can't remove every branch. However, if the compiler cannot predicate a branch, or chooses not to, an IA-64 processor will behave much like a conventional processor: It will try to predict which way the branch will turn, and it may speculatively execute some instructions along the predicted path. Simulations of this strategy indicate that predication can eliminate more than half of the branches in a typical program—and therefore reduce by half the number of potential mispredictions.

This has several benefits. It reduces code fragmentation at the machine level because the compiler can merge small basic blocks into larger blocks that branches don't chop up. Larger blocks give the compiler more freedom to rearrange instructions for parallel execution. It also drastically reduces the hazard of mispredicted branches because every branch doesn't require the CPU to play fortune-teller. And it keeps the functional units busy because the CPU can dispatch more instructions in parallel.

The downside of predication is that the CPU always executes instructions it's going to throw away. Whether the predicated condition evaluates TRUE or FALSE, the CPU does perform redundant work. The trick, of course, is to make sure the CPU saves more clock cycles than it wastes. Clearly, predication assumes that IA-64 compilers will be smart and that IA-64 processors will be very wide superscalar chips with lots of resources to spare. When you're rich, you can afford to spend lavishly.

He Ain't Heavy, He's My Data

Another key feature of IA-64 is speculative loading. Not only will this allow IA-64 processors to load data from memory before the program needs it, it will also

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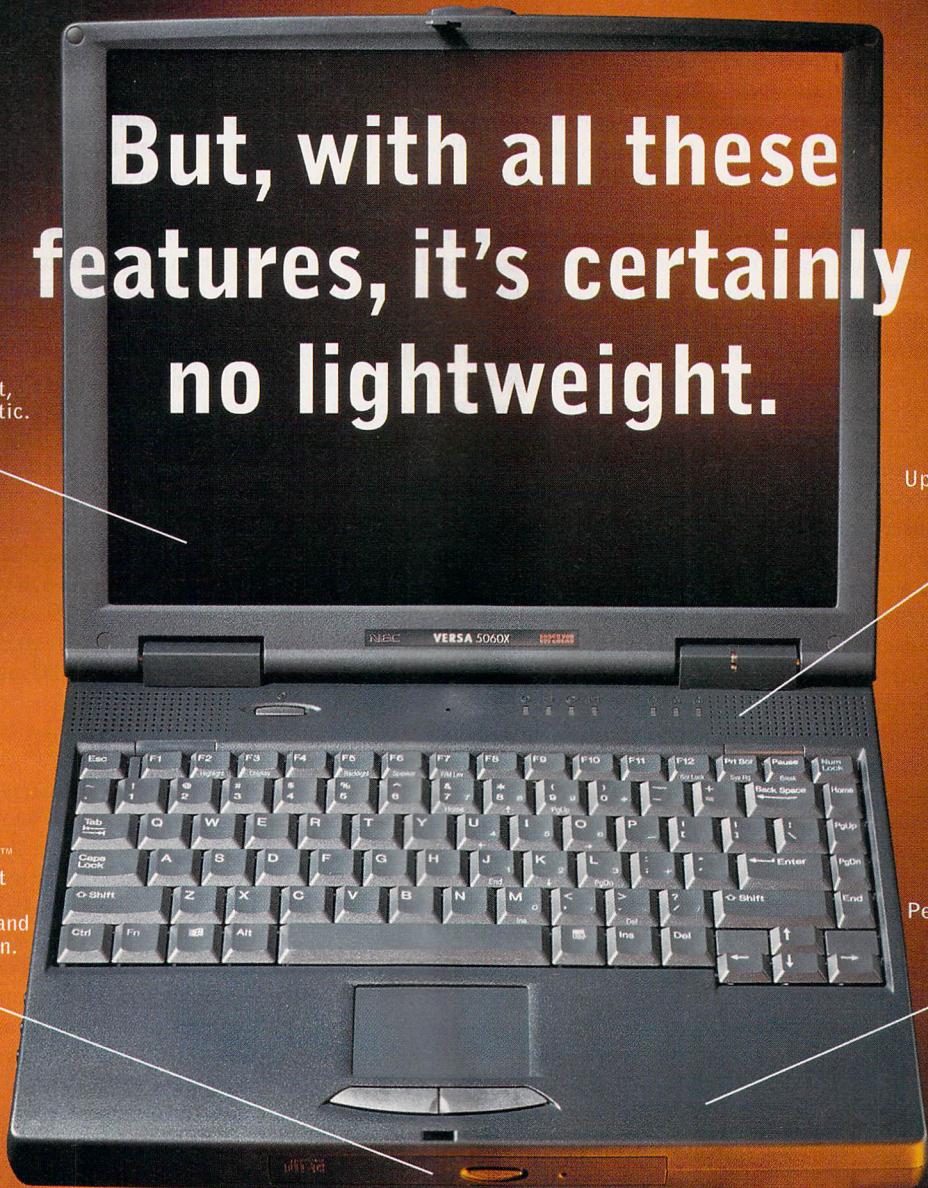
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postpone the reporting of exceptions if the load is not legal. In geekspeak, this technique allows the CPU to *hoist* the load operation higher in the instruction stream—in some cases, even above a branch.

The goal is to separate the loading of data from the use of that data. By paying attention to this, the CPU won't have to twiddle its thumbs while waiting for data in slow memory to show up. Like predication, it's a combination of compile-time and run-time optimizations.

First, the compiler analyzes the program, looking for any operations that will need data from memory. Whenever possible, the compiler inserts a speculative load instruction at an earlier point in the instruction stream, well ahead of the operation that will actually use the data. The compiler also inserts a matching speculative check instruction immediately before the particular operation that will use the data. At the same time, of course, the compiler rearranges the surrounding instructions so that the CPU can dispatch them in parallel.

At run time, the CPU encounters the

speculative load instruction first and tries to retrieve the data from memory. Here's where an IA-64 processor differs from a regular processor. Sometimes the load will be invalid—it might belong to a block of code beyond a branch that has not executed yet. A traditional CPU would immediately trigger an exception. If the program could not handle the exception, it would likely crash.

But an IA-64 processor won't immediately report an exception if the load is invalid. Instead, the CPU postpones the exception until it encounters the speculative check instruction that matches the speculative load. Only then does the CPU report the exception. By then, however, the CPU has resolved the branch that led to the exception in the first place. If the path to which the load belongs turns out to be invalid, then the load is also invalid, so the CPU goes ahead and reports the exception. But if the load is valid, it's as if the exception never happened. (See the figure "How Speculative Loading Works," below.)

Speculative loading is similar to the TRY-CATCH structures in some programming

languages, except that it works at the machine level. In Java, for instance, a TRY statement will attempt a risky operation, such as opening a file. If TRY succeeds, the program continues normally. If the system can't open the file and throws an exception, CATCH grabs it and stops the program from crashing. IA-64's speculative check is a safety valve for exceptions, like CATCH.

This technique, combined with predication, gives the compiler much more flexibility to reorder instructions and increase parallelism. The ability to hoist loads above branches is particularly powerful. Since branches typically occur about every six instructions, they would severely inhibit IA-64's ability to load data from memory long before it's needed. It would be almost impossible to retrofit an existing architecture with these features because the compiler and the CPU must collaborate to make it happen.

Beyond RISC

In the heady days of the 1980s, some RISC engineers ridiculed CISC and foretold the doom of the x86 family. Unfortunately for them, the penalty for underestimating Intel is even greater than the penalty for mispredicting branches. Business and technology are two different things. RISC might be technically superior to CISC, but Intel's vast resources and the momentum of DOS and Windows have kept the x86 competitive.

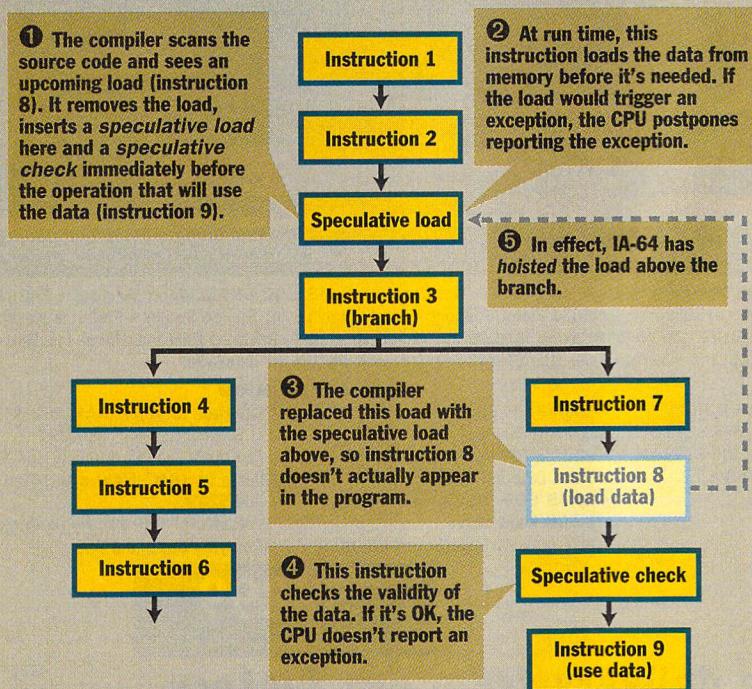
Now, Intel says RISC is running out of gas. Could it be that Intel might be making the same mistake that RISC fans made in the 1980s? Will RISC stave off the IA-64 challenge?

It's too early to tell. However, it's doubtful that RISC vendors can tap the same depth of resources that keeps the x86 alive. The most popular RISC architecture (not counting embedded applications) is the PowerPC. And the only high-volume PowerPC vendor is Apple, a company struggling for survival. Without more business, how long can RISC vendors justify the expensive research and development it takes to battle Intel?

IA-64 chips are still two years away. Intel's competitors—from both the RISC and the CISC camps—have that much time to take the offensive. **B**

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How Speculative Loading Works



BEYOND MMX

AMD, Cyrix, and Centaur are adding new extensions for 3-D graphics to the x86 architecture—without Intel's blessing. Will they split the Wintel PC standard?

By Tom R. Halfhill

Java isn't the only platform showing hairline fractures. While Intel and Microsoft were chipping away at Java, three of Intel's competitors announced proprietary extensions to Intel's x86 microprocessor architecture. Together with Intel's own push for proprietary CPU slots, it makes the taken-for-granted Wintel standard seem a little less solid.

Bulking up x86

The startling news that Advanced Micro Devices (AMD), Cyrix, and Centaur Technology are independently extending the x86 architecture officially broke at the Microprocessor Forum in mid-October, though rumors have been flying for months. The companies also announced other enhancements to their CPUs, including larger caches, backside buses, and superscalar MMX units. (See "AMD's K6 Road Map" on page 88 and "Centaur's WinChip Road Map" on page 92.)

Still, the new 3-D graphics extensions command the most attention because they dare to redefine Intel's 19-year-old x86 standard. Each of these independent x86 vendors plans to add from 12 to 30 instructions to the new versions of their CPUs in 1998. These instructions will dramatically improve the ability of the AMD K6, the Cyrix 6x86MX, and the Centaur IDT WinChip to crunch single-precision floating-point (FP) numbers, which are crucial to faster 3-D graphics.

Although all three companies' instructions are similar, the companies are not acting in concert. The exact numbers of instructions and the instruction formats themselves are different. They are also handling registers in different ways. In effect, the independent vendors are extending the x86 in similar, but divergent, directions.

Leapfrogging Intel

Moreover, they're beating Intel to the punch. Intel has been planning to add its own new instructions as part of an extension called MMX2. Analysts think MMX2 may appear in a Pentium II processor (code-named Katmai) in 1999. That will create a grand total of four different subsets of 3-D instructions.

To guarantee full x86 compatibility, Intel's competitors will almost certainly have to support MMX2 when it appears. So it's likely that future chips from AMD, Cyrix, and Centaur will end up with redundant instructions that do exactly the same thing, only with slightly different opcodes and mnemonics. In the

The Math Behind 3-D Graphics



1 3-D objects consist of hundreds or thousands of polygons, usually triangles.

2 Whenever the object moves, the program must reshape the polygons in a process known as geometry transformation.

3 The program uses matrix multiplication to recalculate each vertex of each polygon. Usually this requires multiplying a 1x4 coordinate matrix times a 4x4 transform matrix.

4 The matrix multiplication requires 16 multiplies and 12 adds, and it yields four results—the new coordinate matrix for the vertex. All the numbers are single-precision floating-point values.

$$\begin{matrix} X & Y & Z & W \\ \text{(Old coordinates)} \end{matrix} * \begin{matrix} A & B & C & D \\ E & F & G & H \\ I & J & K & L \\ M & N & O & P \\ \text{(Transform matrix)} \end{matrix} = \begin{matrix} X & Y & Z & W \\ \text{(New coordinates)} \end{matrix}$$

3-D graphics require lots of floating-point math.

meantime, they'll have the jump on Intel.

"Think of it as an extension of MMX for floating-point and 3-D graphics," says Doug Beard, Cyrix project manager.

"It's everything MMX2 will be, except it's a lot earlier," says Dana Krelle, marketing director for AMD's CPU group.

"Why should we restrict our customers' 3-D graphics performance and make them wait for Intel when we can do it now?" asks Glenn Henry, president of Centaur.

Pity the poor x86 programmer. One of the world's most arcane CPU architectures is about to get even stranger.

Microsoft's 3-D Glue

When a prized piece of china cracks, you fix it with superglue. In this case, the glue is Microsoft's Direct3D libraries for Windows 95 and Windows NT. The good news is that Microsoft is

x86 in 1998

	Intel Pentium II (Deschutes)	Intel Pentium II (Katmai)	AMD-K6 3D	AMD-K6+ 3D	Cyrix Cayenne	Centaur IDT WinChip C6 (C3A)	Centaur IDT WinChip C6
Introduction (estimated)	Mid-1998	Late 1998 – early 1999	Q1 1998	Q3 1998	2nd half 1998	March–April 1998	2nd half 1998
Dual-pipelined MMX	✓	✓	✓	✓	✓	✓	✓
3-D extensions		✓ (MMX2)	✓ (AMD-3D)	✓ (AMD-3D)	✓ (MMX-FP)	✓ (Centaur)	✓ (Centaur)
Direct3D support	N/A	✓	✓	✓	✓	✓	✓
New FP registers*		Unknown				✓	✓
Enhanced FPU**	N/A	N/A		Unknown	✓	✓	✓
Backside bus	✓	✓		✓			✓
Integrated L2 cache	>256 KB (in cartridge)	>256 KB (in cartridge)		256 KB (on chip)			256 KB (on chip)
Fabrication process	0.25 micron	0.25 micron	0.25–0.35 micron	0.25 micron	0.25 micron	0.35 micron	0.25–0.35 micron
CPU interface	Slot 1, Slot 2	Slot 1, Slot 2	Socket 7	Socket 7	Socket 7	Socket 7	Socket 7

✓ = yes

* New physical registers

** Intel-competitive performance

modifying Direct3D to support the extensions from AMD, Cyrix, and Centaur. That should prevent the Wintel PC standard from shattering—for now.

Direct3D is an OS-level API that sits between applications and the hardware. The DLLs and device drivers in Direct3D allow programmers to call high-level 3-D graphics routines without worrying about the low-level 3-D hardware in a system.

A program can query Direct3D to find out if the system has a processor with 3-D acceleration, and then find out which 3-D

functions the processor can execute. Direct3D's hardware abstraction layer (HAL) translates the program's API calls into the parameters that the processor requires. If the system can't execute a particular function in hardware, Direct3D's hardware emulation layer (HEL) uses regular x86 instructions to execute the call in software. (See the figure "Direct3D Architecture," page 90.)

Thanks to hooks built into Direct3D, it won't take much for Microsoft to support the new extensions from AMD, Cyrix, and

Centaur. In fact, the x86 vendors are writing most of the code themselves.

Nevertheless, a repaired piece of china is never as good as an unbroken piece of china. Some programmers who crave maximum performance (especially game programmers) might just bypass Direct3D and write their own graphics routines. They will have to use assembly language because compilers do not support the new instructions. Furthermore, to ensure full compatibility with any PC, these programs will have to query the system at run time to see if it has one of the new CPUs, then call a different subroutine for each chip.

There is also the problem of OSes that don't have Direct3D—namely, all the rest, including Windows 3.1, OS/2, Linux, and other x86 versions of Unix. Applications for those OSes will have to probe the system at run time and call different code if they want to take advantage of the extensions while remaining fully compatible. The same will be true for programs that use OpenGL or any other 3-D libraries instead of Direct3D—unless those libraries support the extensions, too. AMD, Cyrix, and Centaur say Direct3D is their first priority for the mainstream market.

AMD-3D

AMD's extensions—AMD-3D—should appear in a new K6 processor scheduled for production in the first quarter of 1998. There are 24 new instructions, mostly for single-precision FP. They are quite differ-

AMD's K6 Road Map

AMD plans two new versions of the K6 for 1998. The first chip, scheduled for the first quarter, will have the AMD-3D extensions, system bus frequencies as high as 100 MHz, a superscalar MMX unit, and 0.25-micron process technology.

The faster bus will match Intel's frontside bus on the Pentium II, which will run at 100 MHz when Intel introduces the 440BX system chip set next year. Equally significant is the K6's new MMX unit. Current K6 processors can execute only one MMX instruction per clock, while

Intel's chips can execute two per clock. In an attempt to match Intel's multimedia performance, the new K6 will have a dual-pipelined MMX unit.

Currently, the K6's top core speed is 233 MHz. That should soar to 300 MHz and higher as AMD rolls out the more efficient 0.25-micron process at Fab 25 in Austin, Texas.

In the third quarter, AMD plans to release another K6 that has the previously mentioned features plus a 256-KB Level 2 (L2) cache integrated with the CPU core.

The L2 cache will run at the full core frequency over a dedicated backside bus, similar to the Pentium Pro's.

However, the K6's L2 cache will be truly integrated with the CPU. The Pentium Pro's L2 cache is on a separate die in a multichip module. A new Pentium II processor scheduled for introduction in mid-1998, code-named Deschutes, will also have a full-speed L2 cache, but the cache will be on separate static RAM (SRAM) chips inside the Pentium II's Single Edge Contact (SEC) cartridge.

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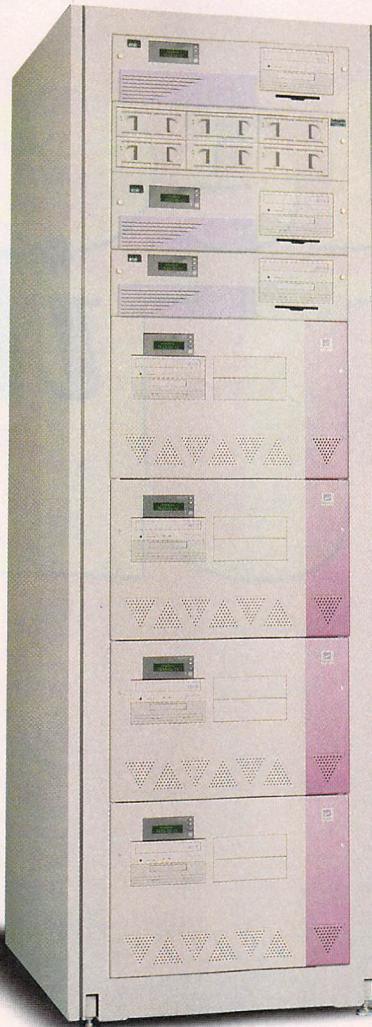
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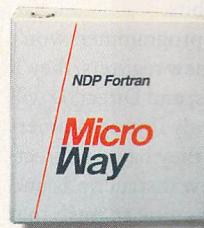
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Geometry Lessons

On the screen, 3-D objects consist of hundreds or even thousands of polygons, usually triangles. The smaller and more numerous the polygons, the more detailed the object.

When an object moves on the screen, rotates to a different viewing angle, or moves forward or backward in virtual space (e.g., scales to a different size), the program must recalculate every vertex (corner) of every polygon. This is a geometry transformation, and it requires

heavy-duty matrix multiplication. Typically, the program must multiply a 1×4 matrix of coordinates against a 4×4 transform matrix. It requires up to 16 multiplies and 12 additions for every vertex. (See the figure "The Math Behind 3-D Graphics," page 87.)

A typical 3-D game object might have 1000 polygons. Each time it moves, that's at least 84,000 multiplies and adds. And that's just to recalculate the wire-frame mesh—it takes even more number-

crunching to wrap the skeleton with a surface texture map.

All the numbers that a geometry transformation manipulates are single-precision floating point values, 32 bits long. RISC chips are generally better at this math than x86 chips. Even the Sony PlayStation and Nintendo 64—home videogame machines that sell for under \$150—have special geometry-transform hardware that blows most PCs into the weeds.

"critical section," like a low-level device driver. It's locked against interrupts. The operating system does not have to save the registers' states or know anything about the extensions. Clearly, Direct3D is all-important to the success of these independent extensions.

Cyrix Cayenne Turns Up the Heat

Cyrix, like AMD and Centaur, says Microsoft will support its new instructions in Direct3D, too. The Cyrix extensions won't make their debut until the second half of 1998—months later than AMD's and Centaur's, but probably still ahead of Intel's MMX2. A Cyrix M2-series processor (code-named Cayenne) will offer 12 to 14 new instructions as part of a subset called MMX-FP. Cayenne will also have faster double- and extended-precision math.

The most interesting difference between MMX-FP, AMD-3D, and Centaur's

ent from MMX instructions, which manipulate integer values. MMX is useful for general multimedia tasks but, contrary to popular belief, it does nothing to accelerate the most basic function of 3-D graphics: geometry transformations (see "Geometry Lessons," above).

To restore honor to the x86, AMD is introducing a multiply-add (MADD) or multiply-accumulate (MAC) instruction similar to those in digital signal processors. It will multiply a pair of 32-bit FP values and add the result to another FP value in a single operation. Today's x86 chips would need two separate operations. Last year, Silicon Graphics added similar instructions to the Mips R5000, resulting in dramatically faster 3-D graphics on Indy workstations.

The K6 will execute the AMD-3D instructions in a wholly new functional unit, separate from the regular FPU. AMD says the unit is pipelined to achieve a peak rate of more than one result per clock.

In a clever twist, the AMD-3D instructions shuffle their operands through the eight MMX registers, which are aliases of the eight-entry FP stack. The AMD-3D registers are therefore aliases of aliases. Future processors could substitute real physical registers for these logical registers without breaking compatibility. Since the AMD-3D instructions don't create any new state in the processor, they don't require modifications to the OS (except for Direct3D, as described earlier).

Centaur's Kick

Although Centaur has barely begun shipping its first x86 chip, the young compa-

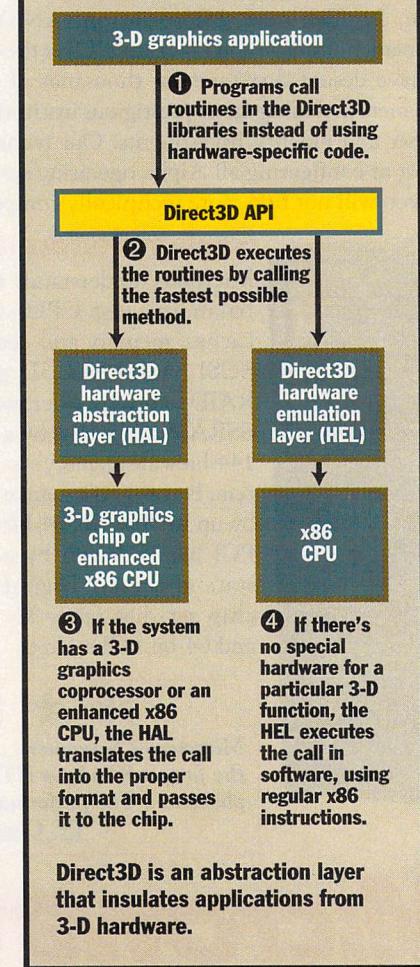
ny has persuaded Microsoft to absorb its new extensions into Direct3D. That puts Centaur's extensions on a nearly equal footing with AMD's. In addition, as with AMD, Centaur has about two dozen new instructions, including a MADD/MAC that achieves one-clock throughput. But Centaur is offering something AMD and Cyrix aren't: new registers.

Centaur's chip will have 30 new registers in all, and they will be addressable registers available to programmers. Twenty-two are actual physical registers on the chip. The other eight are aliases of the FP stack, like MMX registers. All of them are 80 bits wide—big enough to handle extended-precision FP values. Although single-precision FP operands are only 32 bits long, some instructions can generate extended-precision intermediate results that stretch out to 80 bits.

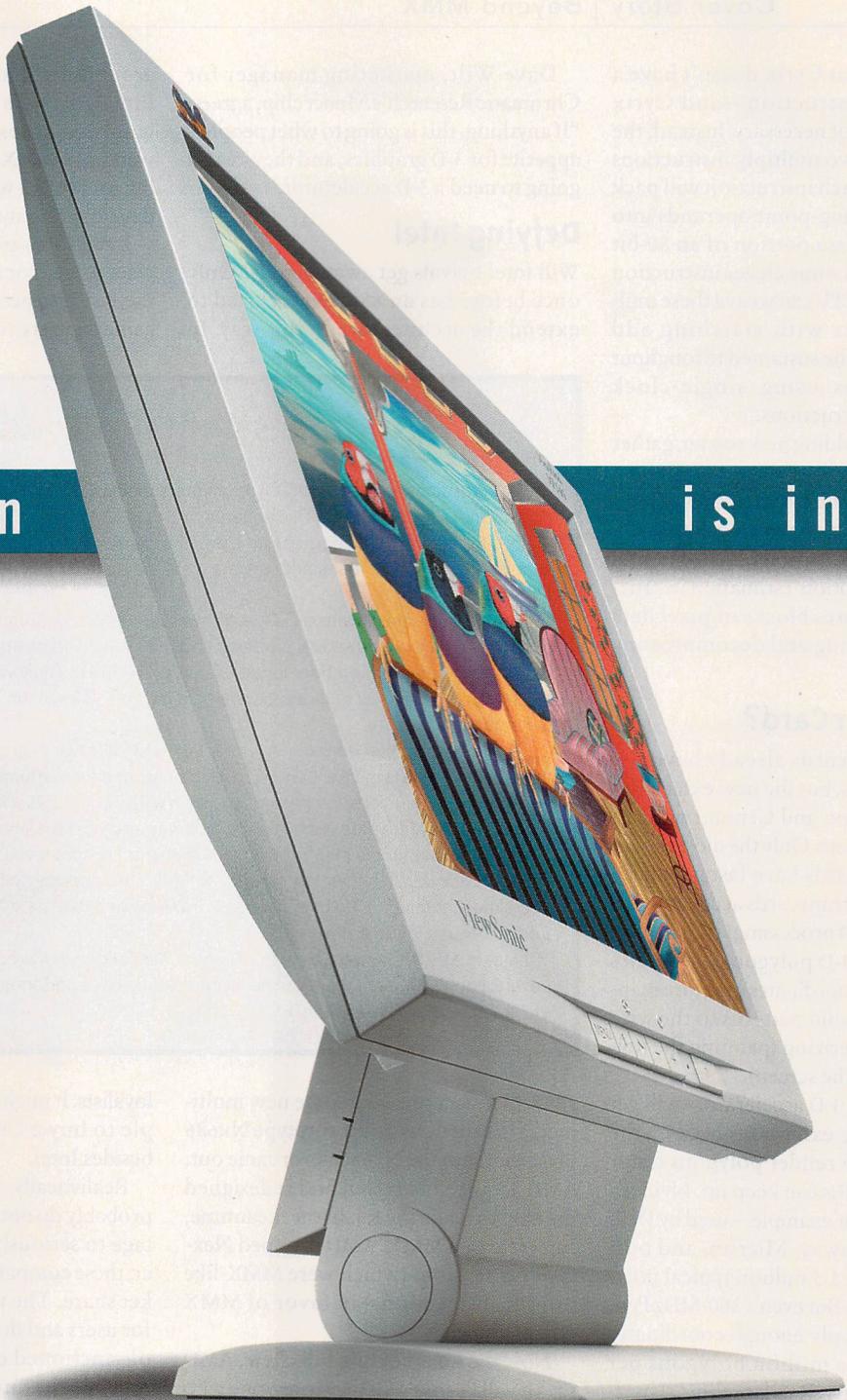
Ideally, application programmers won't have to mess with the new registers; they'll call Direct3D routines, and Direct3D will handle the details. Only if programmers bypass Direct3D will they have to directly manipulate the new instructions and registers. "We're not going to push that because we're not trying to evangelize application developers to write Centaur-specific code," says Centaur's Henry. "We're realistic. We realize we're the smallest potato."

Normally, a new set of logical registers would require modifications to the operating system because the OS has to save the registers' state during a context switch. However, the code in Direct3D that uses the extensions is a nonreentrant

Direct3D Architecture



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extensions is that Cyrix doesn't have a MADD/MAC instruction—and Cyrix claims that it's not necessary. Instead, the CPU will issue two multiply instructions per clock, and each instruction will pack two 32-bit floating-point operands into the 64-bit mantissa portion of an 80-bit FP register. With some clever instruction scheduling, the CPU can weave these multiplies together with matching add instructions, so the sustained throughput is the same as using single-clock MADD/MAC instructions.

Cyrix is also adding new scatter/gather instructions that optimize parallelism when transforming 3-D triangles. There are special instructions for calculating reciprocals and reciprocal square roots, and there's even a motion-estimation instruction that compares blocks of pixel data when compressing and decompressing MPEG video.

3-D: Chip or Card?

Some graphics cards already have 3-D accelerator chips, but the new extensions from AMD, Cyrix, and Centaur will not make them obsolete. Only the most expensive, high-end cards have fast geometry engines. Mainstream cards accelerate the later stages of 3-D processing: triangle setup (converting 3-D polygon coordinates into 2-D screen coordinates), texture mapping (applying solid patterns to the wire frame), and rasterizing (painting the textured object on the screen).

Indeed, some 3-D accelerators will get a boost from the extensions because the accelerators can render polygons faster than existing CPUs can keep up. Nvidia's RIVA 128 chip, for example—used by Dell, Diamond, Gateway, Micron, and others—can render 1.5 million typical polygons per second. But even a 300-MHz Pentium II can't supply enough coordinates for more than a million polygons per second, says Dave Reed, technical marketing director at Nvidia. "This will be great for us," he says. "We've got the headroom to handle it."

Dave Wilt, marketing manager for Chromatic Research's Mpack chip, agrees. "If anything, this is going to whet people's appetite for 3-D graphics, and they're still going to need a 3-D accelerator."

Defying Intel

Will Intel's rivals get away with it? Only once before has an x86 vendor tried to extend the architecture in this way. In

grounds to block its rivals. More likely, Intel will try to persuade developers to ignore rogue extensions to the x86 and wait until MMX2 comes out. Standardizing on MMX2 would make life easier for developers—and for Intel.

But a software developer who doesn't want to wait for MMX2 to arrive could use the fast instructions to write a smash-hit game that gets a one-year jump on the Intel

Centaur's WinChip Road Map

Centaur plans to deliver its 3-D graphics extensions in a new version of the IDT WinChip C6 next March or April. This adheres to Centaur's goal of introducing new chips about every six months. It's an aggressive schedule, but Centaur says the WinChip's relatively simple design makes it easier to revise, test, and manufacture. (See "Keeping It Simple," October BYTE.)

The new chip, code-named C3A, will have several additional improvements. A new super-scalar MMX unit will have dual pipelines and will execute some instructions in fewer clocks than Intel's Pentium chips. For example, Centaur's MMX multiply instruction will have a latency of one clock instead of three. Centaur claims the C3A will run Intel's Media Benchmark faster than a Pentium.

To address another shortcoming, the C3A will offer twice as much FP performance as the C6. Centaur claims the C3A will match or exceed the performance of a Pentium on 80 percent of FP operations. Integer multiplication will be faster, too, and the chip will have branch prediction. Also, the data cache will be four-way addressable instead of two-way.

Although Centaur is sticking with a 0.35-micron process, the company hopes to push clock speeds a little higher, perhaps to 266 MHz. Remarkably, all these improvements will add almost nothing to the chip's die size. It will expand to a mere 90 square millimeters, up from 88 square millimeters now.

Later in 1998, Centaur plans to release a WinChip series processor with an integrated Level 2 cache. That should significantly boost the chip's performance and help keep Socket 7 a viable alternative to Intel's CPU slots.

1995, NexGen revealed some new multimedia instructions in its prototype Nx686 processor. But the Nx686 never came out. AMD acquired NexGen and redesigned the chip to make the K6. In the meantime, Intel released MMX. AMD dropped NexGen's extensions (which were MMX-like integer instructions) in favor of MMX compatibility.

Now the K6 is coming full circle. AMD says it will license AMD-3D to anyone who wants it, but Intel, Cyrix, and Centaur are already moving in their own directions.

It's not clear whether Intel has legal

loyalists. It might even influence some people to buy a CPU from some company besides Intel.

Realistically, AMD, Cyrix, and Centaur probably do not have a big enough advantage to seriously threaten Intel. However, these companies might gain some market share. The more important question for users and developers is whether these unsanctioned extensions (and possibly others in the future) will fracture the Winchip standard.

For now, it appears Direct3D can hold things together. But as Intel drives its own proprietary wedges into the standard (see "Socket to Me," November BYTE), competitors will be hard-pressed to find work-arounds. Don't be surprised if some of those work-arounds spin off in different directions. **B**

WHERE TO FIND

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Centaur Technology
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408-727-6116
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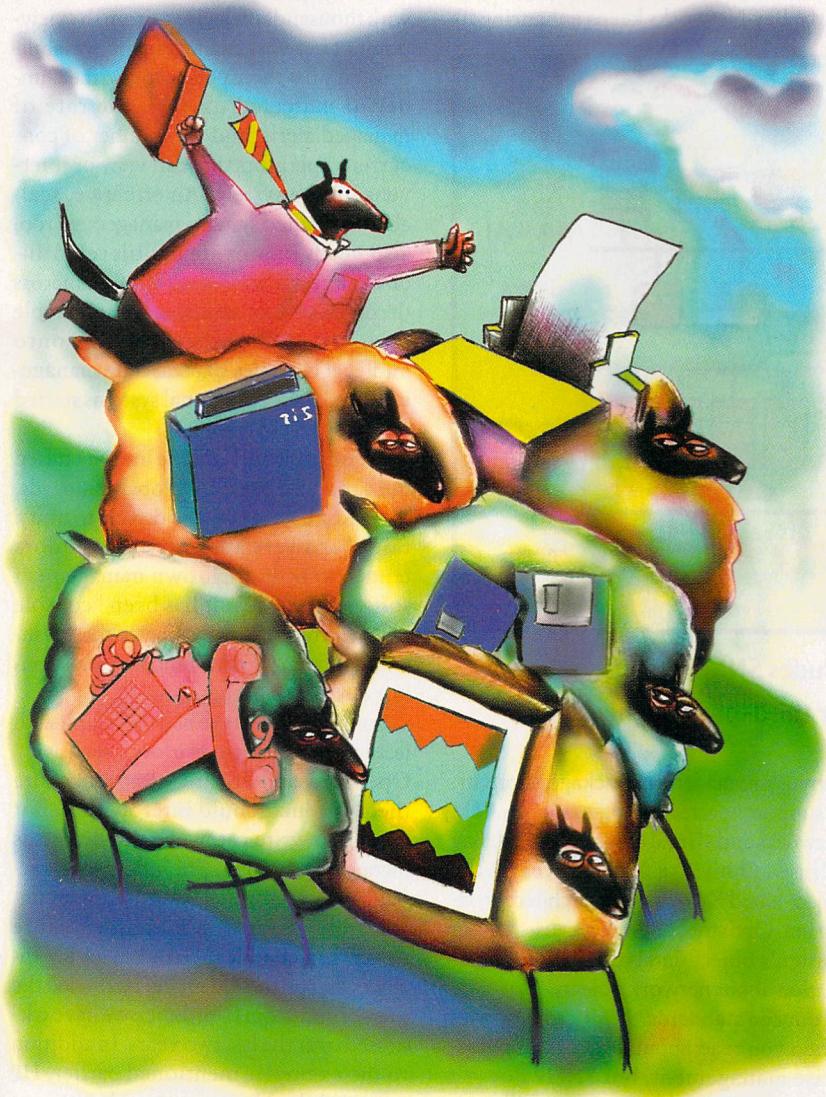
Nvidia
Sunnyvale, CA
408-720-6100
<http://www.nvidia.com/>

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Commanding the Enterprise

Enterprise management vendors must deal with the Internet, function consolidation, and "open" system trends.

By Karen Watterson



Funny thing happened on the way to distributed enterprise management—the Internet. In 1997, CEOs, CIOs, and other upper managers realized how much their businesses rely on the network, that more and more, the network is the business. Even if their firms hadn't implemented extranets or electronic commerce, many had Web-enabled a portion of their mission-critical applications, thereby raising the visibility of the network.

Managers heard about security breaches and began talking about firewalls and single sign-on as though they knew what they were talking about. They began to ask IT how to build more accountability into networks by implementing service-level agreements (SLAs) and demanding policy-based quality of service (QoS) agreements from telcos.

Besides the Internet factor, two other trends are transforming enterprise management. Vendors of systems management and network management tools are continuing the consolidation trend that began in 1996. Computer Associates (CA) bought Cheyenne, Tivoli acquired Unison (leading developer of workload management software for distributed computing environments), IBM bought Tivoli, Boole & Babbage acquired Maxm, Bay Networks acquired Xylogics, Ascend Communications acquired Cascade Communications, HP acquired Uniprise (for database management), and Cisco bought StrataCom and Netsys Technologies. Thanks to acquisitions like these, traditional network management vendors were able to add systems management functionality to their products. Meanwhile, systems management vendors enhanced their products not only with device-level monitoring (associated with network management) but also with application-level monitoring and service-level management.

Probably even more significant to customers, however, is the general move away from proprietary systems toward more "open" and interoperable systems based on standards like Simple Network Management Protocol. SNMP describes how devices and management consoles communicate; it uses agent software embedded in network devices to collect network traffic information and device statistics. RMON, or remote monitor, is a popular and useful extension to SNMP introduced in 1991 to monitor media (as opposed to devices). And now we have another standard emerging: JMAPI, the Java Management API.

It's clear we're moving toward (re)centralized network and systems management. The goal: enterprise management from a single console.

Challenges to Unification

Unifying network and systems management into a single enterprise framework has been an uphill task. Vendors have faced a number of challenges, including:

Network vs. systems management. Network management and systems management have been different and separate tasks, each

with its own staff. "Hardware guys" tended to be responsible for a firm's networks. Initially, these were vendor-specific, host-based systems like those from IBM or Digital and later, Unix and PC-based LANs as well. Systems staff typically tackled operations-center tasks such as backup and recovery, security, software distribution and configuration, and help-desk problems. Like a bad blind date, these two groups seemed to have little in common.

Tool problems. Even their resources seemed to mandate against unity. Network administrators have needed a broad

for example, recently introduced the Cisco Resource Manager, a suite of Web-based management tools that handles inventory and software distribution and works in conjunction with the more device-oriented CiscoWorks. With the combination of CiscoWorks and Cisco Resource Manager, network managers can not only keep track of all the Cisco routers, switches, and other SNMP devices on the corporate network, they can also distribute software to those devices and correlate and analyze system log messages. Similarly, Bay Networks keeps enhancing its

works and eventually had to add gateway agents to let administrators "see" those legacy networks.

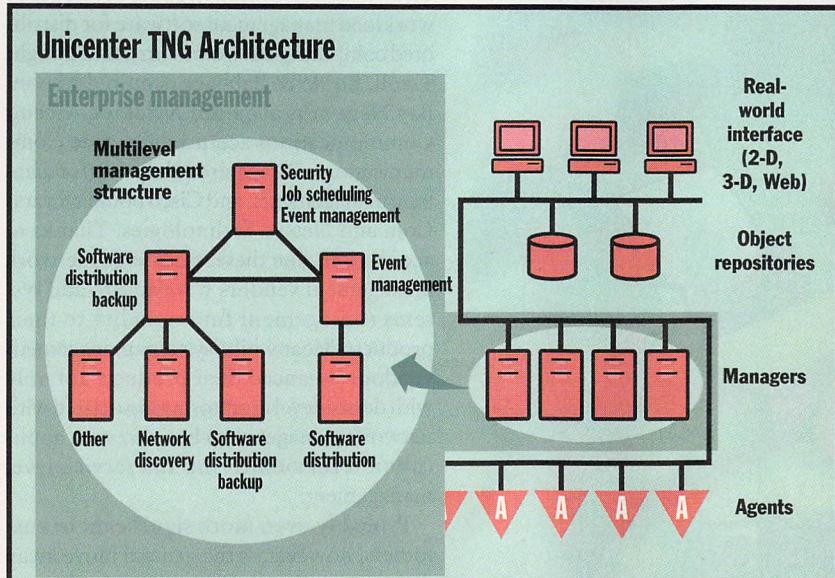
To complicate matters, most software hasn't shipped with built-in SNMP agents. That's beginning to change, especially for database systems, but it's a problem for network administrators expected to monitor databases and applications as well as network devices. A more serious problem for large networks is the basic polling, or response-and-query, method by which SNMP works. It simply doesn't scale well with thousands of devices. From the viewpoint of network management, scalability usually has three perspectives: the number of managed objects, the rate of managed alerts, and the number of concurrent operators that can view or intervene on the system. An effective, scalable distributed systems management tool also needs to provide multilevel, drill-down access to all managed objects across the enterprise. In addition, it must be able to distribute intelligent agents onto midlevel consoles that cascade management tasks out to regional systems staffed by lower-level personnel.

Console creep. Until the Internet raised the bar on the need for global standards, there had been another obstacle to unity. Both hardware and software vendors tended to offer their own management software. The result has been "console creep," where console refers to the "dashboards" from which administrators monitor devices or processes.

Some vendors have been working with leading management platforms such as HP OpenView and Tivoli TME to make sure their products could interoperate. But having to write gateways and drivers is inconvenient at best. The industry has recognized that customers want a single console from which to monitor their entire network, including their intranets. In other words, customer demand has fueled the merger and acquisition binge we have witnessed over the last two years. In addition to the examples mentioned earlier, HP acquired the Norton network management tools from Symantec, and Digital sold most of Polycenter to Computer Associates, with IBM/Tivoli picking up Polycenter Manager for use with NetView.

Other vendors, notably Boole & Babbage and Candle, approached the problem by creating "manager of manager" consoles with their Command/Post and Command Center products, respectively.

continued



CA's Unicenter TNG architecture includes SNMP agents, gateways to legacy networks, and hooks for third-party applications.

range of tools to monitor and administer the network. Dozens of such tools have emerged, especially for the proprietary host-based networks from IBM and Digital, where tool vendors could charge "mainframe" prices. As Unix and TCP/IP and LANs made inroads into the corporate scene, networks became more complex, managing them became more difficult, and lower-cost PC LAN management tools appeared. Then, in the '90s, Unix-based network and systems management consoles such as IBM NetView, HP OpenView, and CA-Unicenter (now called Unicenter TNG—for "The New Generation") emerged as the tools of choice for overseeing increasingly multivendor networks.

Device tool competition. Network devices themselves are shipping with increasingly sophisticated monitoring software of their own. Router giant Cisco,

network management package, Optivity, to support new technologies such as ATM networks and virtual LANs. In the fall, Bay released Optivity 8.0, which weaves the object-based Xylogics' Net Architect product into Optivity. Net Architect uses Object Design's object database to store information about network objects.

Unused standards. SNMP crops up a lot when you read about network or enterprise management, but SNMP doesn't solve all your problems. SNMP still can't manage many network devices. So-called legacy networks such as IBM's Systems Network Architecture (SNA) and Digital's DECnet were never designed to be SNMP-compliant. CA's Unicenter TNG, for example, relies on SNMP and other agents to gather information about the status of devices on the network. It initially shipped without support for SNA or DECnet net-

Frameworks, NT, Internet

Besides industry consolidation, four additional trends are evident. One is the *framework*, a foundation of services (such as CA Unicenter's Framework and Microsoft's Management Console) into which you can plug additional products.

The second is Windows NT. While many struggle to combine network and systems management into single products, frameworks, or suites, dozens of new tools designed specifically for NT networks have emerged, such as AppManager, from NetIQ, and DynaMeasure, from Bluecurve. Existing management platforms, which had been available only under Unix, were also ported to NT. Both Unicenter TNG and Tivoli TME 10 have been ported to NT.

The third trend—a revolution in distributed network management—is the Internet. The Internet, after all, promises platform-independent network management, where theoretically any browser can retrieve management data anytime, from anywhere. It's no surprise that vendors in all categories of tools are scurrying to offer Java interfaces to their products. The jury is still out, however, on the feasibility of such an architecture.

New standards are the fourth trend. The Java Management API (JMAPI) functions were just finalized in 1997, so such tools are not yet available, although they're sure to emerge. The same is true for the Web-Based Enterprise Management (WBEM) initiative, spearheaded by Microsoft and some 60 other vendors—including HP, Tivoli, and Cisco. Central to WBEM is the Common Information Model (CIM), which provides a common way to describe and share management information across the enterprise. Expect to see products that support CIM by early 1998. The Advanced Configuration and Power Interface for Windows should result in better power management and also solve the thorny problem of managing powered-down systems.

Enterprise Managers: The Short List

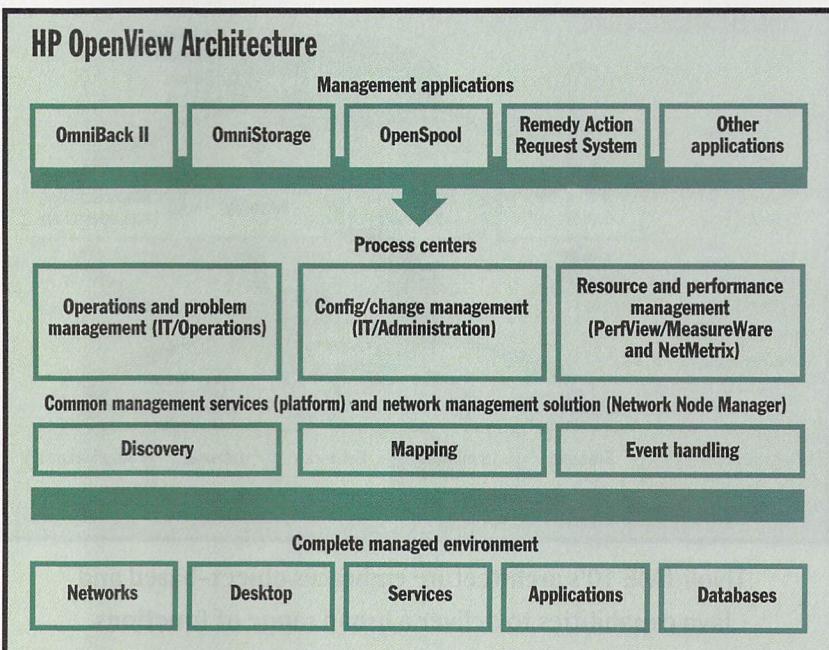
Customers expect a lot from today's systems, such as:

- Automatic discovery of network devices, including across virtual LANs and virtual networks
- Asset management
- Graphical views of networks and net-

- work statistics
- Service-level management (SLM)
- Capacity planning
- Disaster planning and recovery
- Job scheduling, with batch execution, file transfer, and conditional scheduling
- Software distribution
- Security management and user administration, including single sign-on
- Audit trail for configurations/changes
- Event-based triggers (e.g., low disk space)
- Bandwidth and utilization prediction
- Support for application monitoring and administration (e.g., database, help

platform on the market today. With over 120,000 installations, it's also the market leader. OpenView's strength is network management based on an extended SNMP manager/agent model that adds some systems and LAN management. OpenView consists of five manager components:

- Network Node Manager (NNM) for network management
- IT/Operations for operations and problem management
- IT/Administration for configuration and change management
- PerfView and NetMetrix for resource



HP OpenView is a nearly full-fledged enterprise management system that interoperates with many third-party products.

desk, and other client/server applications)

- Virus protection

Plus, customers expect proactive, not just reactive, systems—even systems that can “heal” themselves. Add Web site management, TCP/IP address management, and directory services and you'll understand why the marketplace is crowded, confusing, and dynamic.

We have identified three products that seem poised to leverage their market dominance as they evolve into true distributed enterprise managers: HP OpenView, IBM's Tivoli TME 10, and Unicenter TNG. Microsoft's products remain a wildcard.

HP OpenView

HP OpenView is the oldest (1990) and best-known Unix-based management

and performance management

- OmniBack II for backup management

Additional functionality comes from Norton Administrator for Networks and from Expose agents (which perform automatic error-handling such as alarm notification by pager or e-mail). All OpenView components, except for IT/Operations and IT/Administration, have been ported to NT. The two core components are on schedule for NT availability in late 1997 or early 1998.

OpenView's strengths are its market share, large third-party applications base (Raptor Systems' RaptorView firewall, for example, can pass data up to OpenView), and centralized network and performance management. However, customers complain: HP is slow to market (like the miss-

ing NT components and incomplete integration of the Norton products); OpenView lacks a single, central database for network information; OpenView is losing market momentum. Worse, HP's announcement at Computer Associates' CA-World '97 that HP would support Unicenter was widely seen as a retreat.

Not all the news is bad, however. Last summer, HP announced agreements with Dell, Silicon Graphics, and Stratus. They will ship HP's new OpenView-Ready Network Node Manager (HP OpenView

ture quickly, but integrating IBM's NetView, including MVS support, is still under way. Meanwhile, the new Global Enterprise Manager (GEM) will add application management and monitoring to TME 10.

TME 10, like HP OpenView, consists of many modules, including: Tivoli Enterprise Console (TEC), which can display NetView messages; Distributed Monitor; NetView; NetView Mid-Level Manager; Performance Monitor; Reporter; User Administration; Security Management; Job Scheduler; Remote Control; In-

configure, deploy, and maintain services based on the widely used TMN standard. On the downside, TME 10 lacks end-to-end network management (currently under development), and some fault it as being too modular. Tivoli/TMN competes with Sun's Solstice Enterprise Manager, also popular in telecommunications. However, some observers perceive Sun as having lost momentum and leadership in network management. Sun Microsystems president Ed Zander admits, "We didn't keep the kind of pace we should have. We still have work to do."

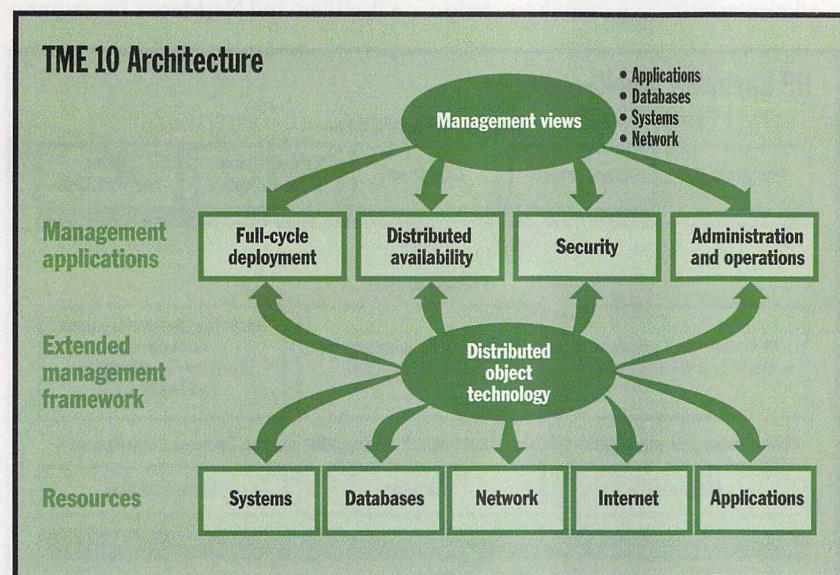
Aware of demand for Java clients, Tivoli planned to have shipped a Lightweight Client Framework (LCF) by the time you read this. The Windows 95-hosted LCF will use a combination of Java and CORBA, the first step in a planned TME 10 evolution to supporting Java APIs.

Computer Associates

With the July debut of Unicenter TNG at CA-World '97, Computer Associates' Unicenter systems management product morphed into an enterprise management suite, based on a "free" framework. Consider what CA gave away on a CD-ROM to over 20,000 CA-World attendees:

- Auto Discovery identifies SNMP-compliant and TCP/IP devices, but not DECnet or SNA devices.
- Object Repository creates a database of all collected information, including device properties like version or release category. The current repository is based on Microsoft SQL Server 6.x: CA's own object-oriented "Jasmine" isn't ready yet. The full product also supports Oracle.
- 2-D and 3-D Mapping user interfaces give administrators 2-D or 3-D views of the network; 3-D mapping uses animation and Virtual Reality Modeling Language (VRML) to simulate floor plans of devices in a building. A powerful marketing tool.
- Scheduling and Event Management stores definitions of policies and acceptable operational thresholds (e.g., disk space) and provides job scheduling.
- Canned reports, plus customizable reports and charting.

CA, with its large mainframe customer base, should get credit for seeing the NT wave before competitors. Thanks to an agreement with Microsoft's BackOffice team, CA shipped Unicenter TNG for NT months before a Unix version. The com-



Tivoli TME 10's architecture embraces object-based and Java capabilities to deliver a broad range of functions.

"Lite") with some of their servers. Many viewed the announcements relating to OpenView-Ready NNM as the closest HP has come to the "give it away" distribution championed by Microsoft and Netscape. Another important initiative is HP's positioning OpenView as the vehicle for service-level management. HP isn't alone in promising SLA/SLM, however. Boole & Babbage promises proactive "desired state management." Even Network General, whose Sniffer is widely considered the Cadillac of network monitors, is moving up the enterprise chain and offering a service-level manager—built with technology acquired from 3DV Technology earlier this year.

IBM's Tivoli

Tivoli, a subsidiary of IBM since 1996, has evolved from a basis in systems management. Tivoli integrated IBM's SystemView into TME 10's object-based architec-

ture Management; Print Management; Software Distribution; Inventory; and DBMX (recently acquired, for heterogeneous database administration).

Tivoli also offers modules to interoperate with products like SAP and BMC. As you'd expect, a DB2 Enterprise Control Center for TME 10 modules lets TME administer DB2 databases.

Tivoli has embraced the Common Object Request Broker Architecture (CORBA) ORB-based approach to distributed management. Its policy- and profile-driven management is an advanced, object-based design that permits multiple management domains and includes extensive security features. In late summer, IBM shipped an integration module, TMN Enterprise Management Feature, that links IBM's Telecommunications Management Network (TMN) Support Facility with TME 10. Telecommunications service providers can now remotely install,

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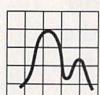
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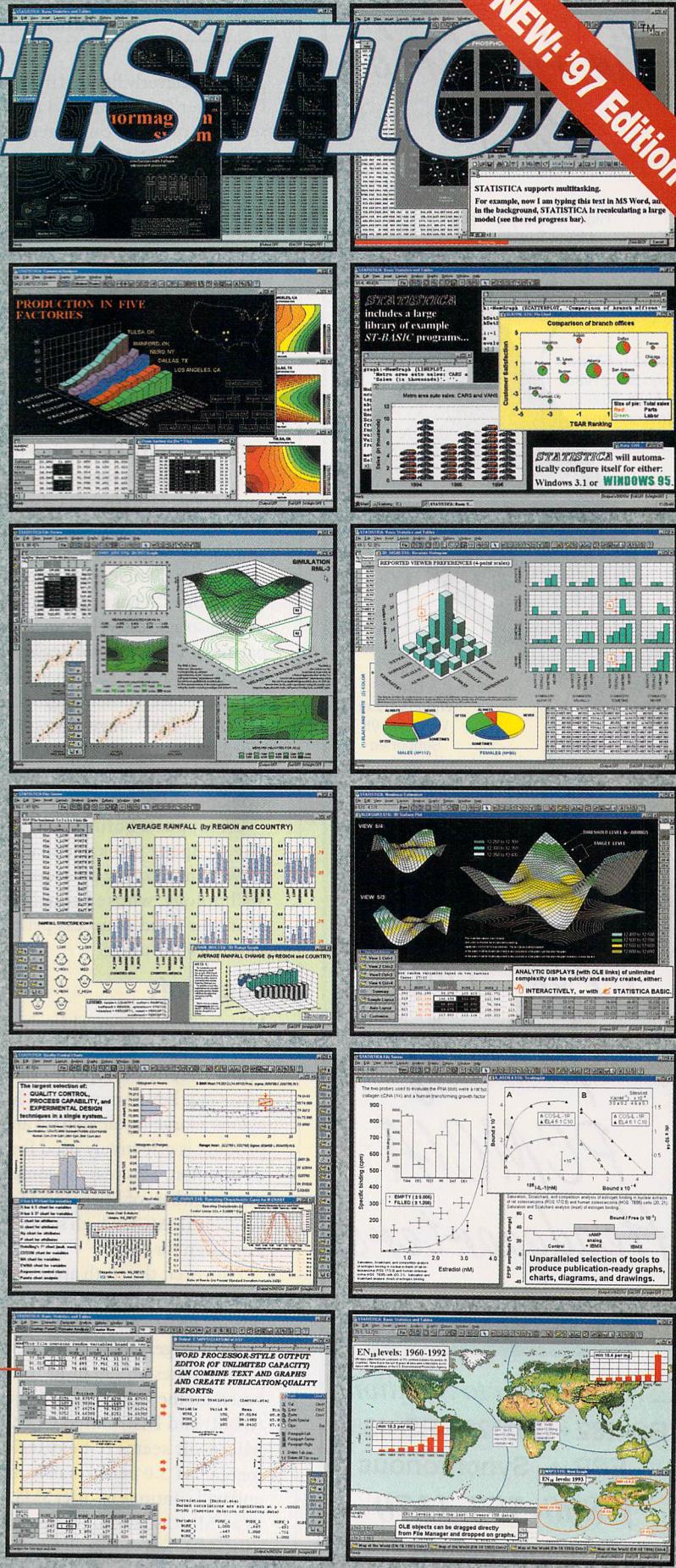
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An Insider's View...



Pictured Above: Serial Communication PC-Card Designed & Manufactured in the USA by Quatech.

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Managing Data

pany also cleverly flooded the market with Unicenter CD-ROMs and free two-day seminars on using Unicenter TNG.

Unicenter TNG's architecture consists of the WorldView UI with its Common Object Repository and the Enterprise Management part, with fundamental manager/agent functionality and the Agent Factory API.

CA is on a roll with TNG. With this NT-based product, administrators get not only the appealing 3-D interface but also business views of enterprise resources and an object-based, extensible architecture that should serve well into the future.

Despite initially lacking it, CA now offers TNG users both SNA and DECnet support (at extra cost). CA also offers TNG for Digital Unix and OpenVMS, to manage legacy Digital systems and upgrade from Digital Polycenter, most of which technology CA has acquired.

CA also aggressively courts third-party partners. The National Registry, Inc., for example, offers finger-image-based NRI-identity Secure Authentication Facility for TNG (SAF/TNG), augmenting TNG's password-based log-on. From Unicenter you can access SAP, HP OpenView, and Cabletron Spectrum.

CA supports both JMAPI and WBEM. The company plans to enhance support of Web monitoring by acquiring Sequel Technology, whose Sequel Net Access Manager handles access privileges and monitors Net usage.

Microsoft

Microsoft has been shipping Systems Management Server (SMS) for several years. Despite perceptions that SMS has poor market penetration, Microsoft claims a large installed base and says the product is effectively used for software distribution. This year the company began shipping a beta of Microsoft Management Console (MMC), which some mistook as a bad sign for SMS.

However, the truth appears to be that MMC will be built into the upcoming Windows NT 5.0 to provide fundamental network management services. MMC's architecture relies on "snap-in" components based on the Component Object Model (COM) and Distributed COM (DCOM). Microsoft seems to be offering fundamental NT 5.0 performance monitoring and will continue to offer SMS, including as an MMC snap-in. As new servers roll out, SQL Server and Exchange will

Commanding the Enterprise

undoubtedly also have snap-ins that allow monitoring from a common console. Expect third-party vendors to provide product snap-ins as well.

Soup to Nuts

Network managers face challenges their predecessors never imagined: heterogeneous networks, demands for better accountability, and a wildly dynamic marketplace. No surprise that the Gartner Group predicts that by 2000, 75 percent of organizations will outsource some network management function.

We have focused on the "soup to nuts" enterprise management tools emerging as market leaders. Yet there are dozens of other products available. Not all IT shops

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embrace enterprise management consoles, opting perhaps for "best of breed" point solutions or their own solutions. Unfortunately, there are no simple answers. You must consider your own infrastructure, your staff skills, and how important integrated application and SLA monitoring are to you. But if you are considering a decision about an enterprise management tool, you now have the fundamental information you need for your evaluation. **B**

Karen Watterson (San Diego, CA) is a writer and consultant specializing in database and data warehousing issues. She is author of several books and is editor of Pinnacle Publishing's Visual Basic Developer and SQL Server Professional newsletters. You can reach her at karen_watterson@msn.com.

Building applications from objects is a good thing. But every programming language seems to have its own idiosyncratic notion of what an object is. C++, Java, Delphi, and even Visual Basic each support objects in some way, but the differences among them can cause confusion for developers. Those differences also create difficulties for vendors that want to provide object services in a standard way to their customers working in any language.

The sensible thing, then, is to define a single object model that can be used across all languages. Once that object model exists, services that the operating system (or applications running on that operating system) provides can all be exposed in a common way, regardless of the language they're written in.

It Don't COM Easy

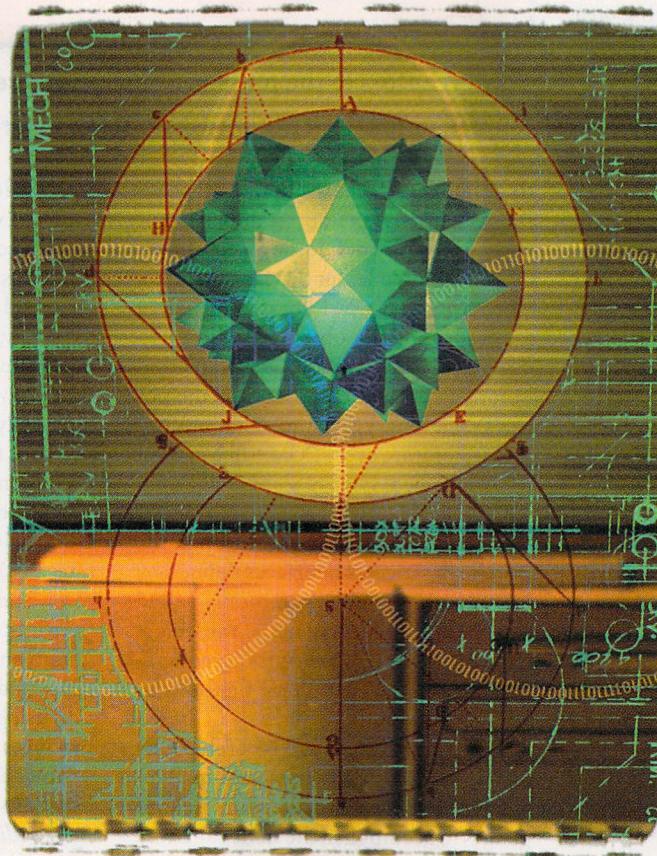
This is exactly what Microsoft's Component Object Model (COM) does. It defines a language-independent notion of what an object is—how to create objects, how to invoke methods, and so on. This allows development of components that programmers can use (and reuse) in a consistent way, regardless of which languages they use to write the component and its client.

COM has been very successful. Today, it underlies a great deal of what all of us do when we use Windows. Something as routine as double-clicking on a file icon to open the associated application, for example, actually relies on COM under the covers. Yet, despite its success, a good number of developers see COM as more than a little challenging to understand and use. The reason for this is simple: Using COM's language-independent objects in any real programming language requires understanding a new object model—the one defined by COM. For example, a C++ programmer knows that creating a new object requires using the language's new operator, while getting rid of

COM+: The Next Generation

Microsoft's COM+ will bring significant changes to today's most widely used object model. Will it make life easier for developers?

By David Chappell



that object requires calling `delete`. If that same C++ programmer wants to use a COM object, however, she can't do things in this familiar way. Instead, she must call the standard COM function `CoCreateInstance` (or one of a few other choices) to create the object. When done with this COM object, she doesn't delete it explicitly, as in C++, but instead invokes the object's `Release` method. The object relies on an internal reference count that it maintains to determine when it has no more clients, and thus when it's safe to destroy itself.

COM is not prohibitively difficult to learn and use—if it were, it wouldn't be the popular technology that it is today—but it does require extra effort by developers. While this would likely be true of any language-independent object model, it would be ideal if that effort were minimal. Achieving this ease of use is a primary motivation for Microsoft's next generation of COM, dubbed COM+.

Making the Tools Do More

Making a software technology easier to use often means changing the tools we use to work with that technology. This is exactly what COM+ will do. It will make the tools do more, so the developer is free to do less.

COM has always been relatively straightforward to use from some languages. Visual Basic programmers, for example, must make some COM-specific calls, but VB itself hides many of the details. Microsoft's implementation of the Java virtual machine makes COM's integration with Java even simpler—it allows Java programmers to write ordinary Java code, then silently performs any necessary translations. But for C++ developers, using COM means understanding a significant number of COM-specific rules and API calls (see the figure "Classic COM," page 101). While COM+ will bring some changes to developers working in VB, Java, and other higher-level languages, it's C++

programmers who will most appreciate it. Because COM+ relies on the C++ compiler to do much of the work of translating between this language-independent object model and the C++ object model, the developer's life becomes easier.

In "classic" COM, objects and their clients make calls on a standard COM library. In languages like Visual Basic and Java, some or all of these calls are hidden, but C++ programmers use this library directly.

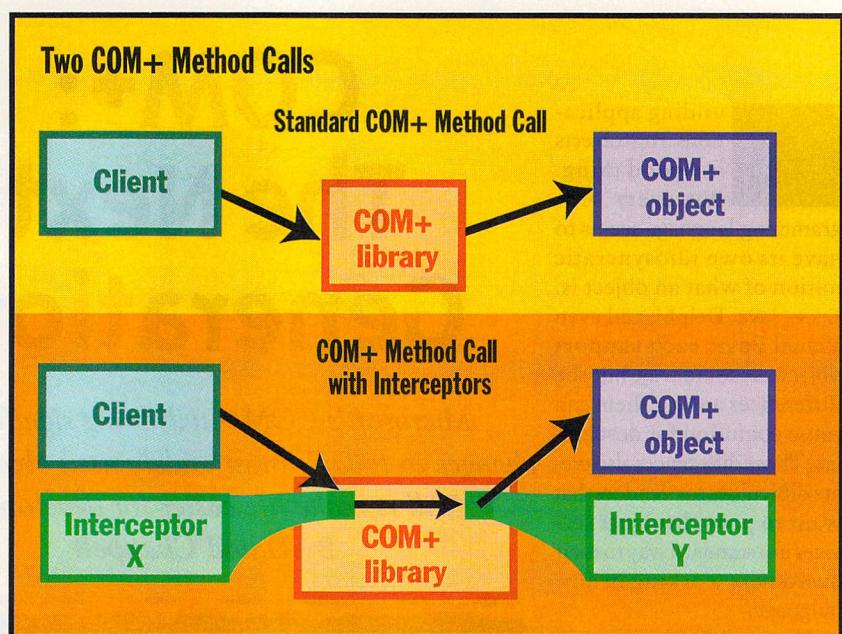
COM+ still provides a standard library, and objects and their clients still use it. But in contrast to COM, COM+ hides calls to this library beneath the equivalent native functions in the programming language. C++ programmers, for example, can use the standard new operator rather than CoCreateInstance to create a COM+ object. In doing so, they are relying on a C++ compiler that is aware of COM+ to generate the correct code to call the COM+ library (see the figure "COM+", page 102).

To accomplish this, the compiler uses the COM+ library at compile time, then embeds calls to this same COM+ library in the generated binary. Microsoft will provide this library, and any language tool that wants to use COM+ must rely upon it. Unlike classic COM, where only COM objects and their clients use the COM library, COM+ also requires compilers (or interpreters, such as those for Visual Basic, and scripting languages, like JavaScript) to rely on a standard library to produce the correct code. Microsoft's competitors in the tools market, already accustomed to working on top of their competitor's operating system, now face the prospect of depending on yet another Microsoft-supplied component for key functions. The benefit, however, is that doing this will make using Microsoft's language-independent object model easier for their customers, too.

Metadata's Importance

Today, a COM object defines the methods it supports in some number of interfaces, each of which can be described using COM's interface definition language (IDL). A tool (the MIDL compiler) then compiles an object's IDL to produce a type library, commonly stored in its own file. Clients of the object can (but don't have to) read this library to learn how to make calls on the object's methods.

In COM+, developers no longer need



Interceptors in the path can check client security, stand in for the object, or perform other tasks, but they increase the call's overhead.

to define interfaces using IDL. Instead, they can just use their programming language's syntax to define the object's interfaces. The compiler for that language then works with the COM+ library to generate metadata for the object. Metadata—essentially a superset of the information in today's type library—goes in the object's same binary file. And unlike optional type libraries, every COM+ object must have metadata.

Even more interesting, COM+ object metadata will be accessible through the generic data access interfaces defined by OLE Database (more commonly called OLE DB). This lets clients of the object issue SQL queries against its own metadata, in order to search for methods or parameter types.

One obvious problem: Not relying on the current IDL might mean adding syntax extensions to programming languages to accomplish the same function. Microsoft can use whatever interface definition syntax it chooses for Visual Basic, since it owns the language. Java already has standard language constructs for specifying interfaces. But C++, which will benefit most from COM+, currently has no standard way to specify interfaces. Although plans are not yet finalized, Microsoft says it intends to extend the language syntax by implementing an interface definition scheme

in its widely used Visual C++ compiler.

Since every COM+ object has metadata, it's also possible to approach marshaling consistently. Marshaling is packaging a method call's parameters in some standard way, allowing these parameters to move effectively between objects written in entirely different languages or running on entirely different machines. COM today provides two very different solutions to perform marshaling.

If an object exposes its methods using a vtable interface (also called a custom interface), its client typically relies on a proxy and stub to marshal and unmarshal the parameters for calls to those methods. A stub and proxy can be automatically generated from an interface's IDL definition using the same MIDL compiler that produces type libraries.

The other way is for a COM object to expose its methods using a dispatch interface (or *dispinterface*). In this case, a client need not rely on a proxy and stub for marshaling and unmarshaling. Instead, the client can read an object's type library, then dynamically perform marshaling as required. This is a more flexible system; however, since not all COM objects have type libraries, it's not always possible in practice today.

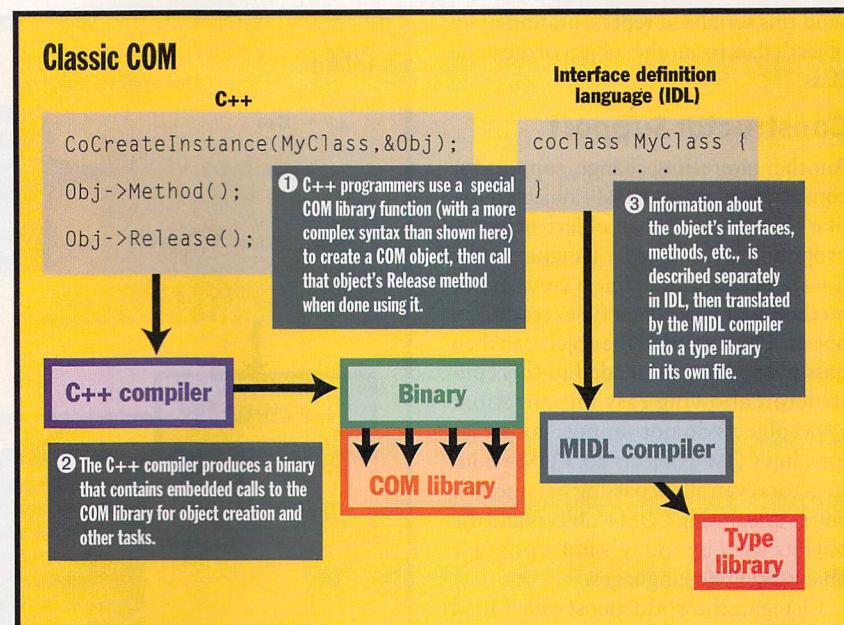
But every COM+ object has metadata, the new equivalent of a COM type library. So COM+ can potentially get rid

of proxies and stubs altogether, allowing a single consistent type of marshaling. COM+ also does away with the distinction between vtable interfaces and dispinterfaces, an inconvenient artifact of the way COM grew. While Microsoft has indicated that the first release of COM+ might still need proxies and stubs, the intent is clearly toward dynamic marshaling as the standard approach.

COM+ addresses yet another important but challenging problem in creating a language-independent object model: data types. Different languages support different data types, which causes problems when passing parameters between objects written in different languages. C++, for example, supports structures, while Visual Basic does not. Today, COM supports one set of data types for vtable interfaces (defined with C++ in mind) and yet another more limited set of data types for dispinterfaces (created with Visual Basic in mind). COM+ gets rid of this historical distinction by defining one common set of data types that is usable across all interfaces and then relying on the COM+ library to perform any translations that are necessary.

Other COM+ Features

COM+ brings many other changes to the COM we know and use today. One of the most important: COM+ eliminates the need for clients to call `Release` when they are done using an object. Instead, the COM+ library automatically handles reference counting—always one of COM's



COM entails a two-part process, involving the C++ compiler and the separate MIDL compiler to produce object information.

most error-prone areas. And while COM has always supported interface inheritance, COM+ also allows implementation inheritance between COM+ objects running in the same process. Despite years of arguing that this was not a desirable feature for a component model, Microsoft appears to have yielded to the demands of at least some of their customers and added this feature.

COM+ also changes COM's persistence model. Today, the creator of a COM object

must typically implement one or more of a fairly large set of interfaces related to persistence. A client of this object then calls various methods in those interfaces to have the object load or save its persistent state. But the COM+ library provides standard support for persistence, removing much of the burden from the COM+ object implementor. And by representing an object's properties in a standard way ("serialization"), COM+ lets you pass objects by value. All that's required is to

Interceptors Add Object Functionality

In COM today, the COM library is not directly involved when a client calls a method in a COM object. Instead, the call goes directly from the client to the object. In COM+, this is no longer true. All COM+ method calls pass through the COM+ library, although Microsoft promises that the overhead this incurs will be negligible (see the figure "Two COM+ Method Calls," page 100). Since COM+ is involved in every method call, it's now possible to insert other objects in that path. A COM+ object that is automatically invoked during access of another COM+ object is called an *interceptor*.

One or more interceptors can lie in wait along the path (as shown in the figure on page 100). For example, an interceptor might perform a security check on the client, then cause the method call to fail if the necessary permissions aren't in place. Doing this allows keeping the authorization logic separate from the business logic in the component the client is using.

Interceptors could also be used to manage the state of the destination object. An interceptor might stand in for the object itself, allowing

a client to believe the object still exists when it has actually deactivated. Doing this allows building much more scalable applications, and it is very similar to what the Microsoft Transaction Server (MTS) does today. In fact, Microsoft plans to restructure MTS using interceptors when COM+ is available. An interceptor could even perform load balancing, transparently distributing method calls to various equivalent objects in turn.

By placing specific attributes in the client code, the client can determine which interceptors load when using a particular COM+ object. But, despite their convenience, interceptors suffer from one potential drawback: performance. Having to traverse a sequence of interceptors on every method call to an object is bound to slow things down.

Microsoft's expectation is that interceptors will primarily be for system-level functions: for the most part, a few highly optimized COM+ objects will be the most commonly used choices. Still, there are likely to be many situations where the convenience and flexibility of interceptors outweigh the performance hit they bring.

send this serialized representation of an object's data to another object of the same class.

Constructor Support

Another interesting change, support for constructors, makes COM+ objects more like objects in a typical object-oriented programming language. Languages like C++ and Java can define a constructor method that runs when first creating an object. The creator of the object can then pass parameters as needed to this constructor, allowing easy initialization. COM objects do not support constructors, but COM+ objects do. COM+ constructors even allow passing parameters, better integrating COM+ objects and the objects used by today's most popular object-oriented languages.

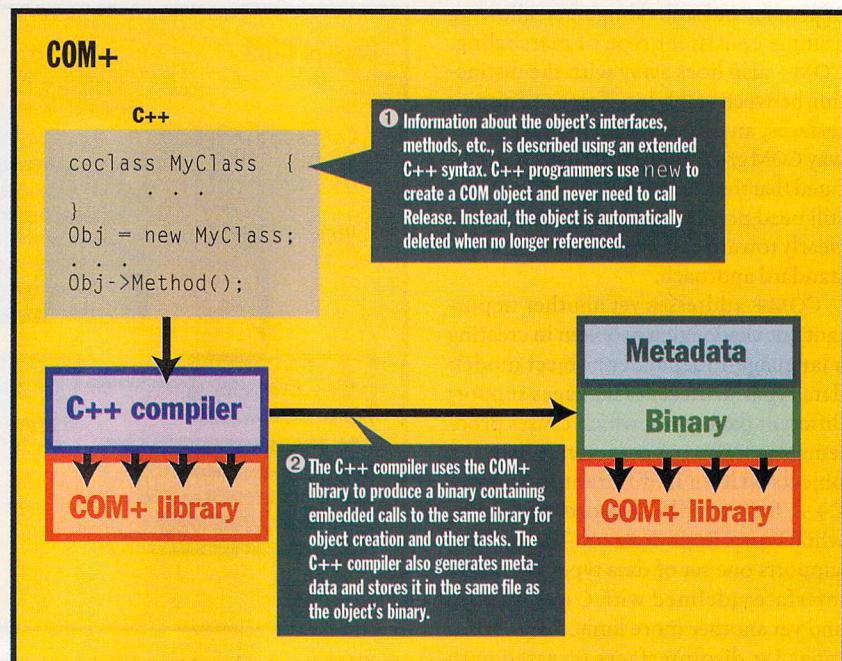
Changing the world's most widely used system object model will not succeed if it breaks the millions of lines of existing COM-based code. But Microsoft has not ignored interoperability. A client will be able to treat a COM+ object like a COM object, and COM+ clients will be able to use COM objects. Further, COM+ does not change the wire protocol that Distributed COM (DCOM) uses, so network communication will stay unchanged.

Complications

By making it so central to Windows and Windows NT programming, Microsoft has all but forced developers to use COM. This has not been a bad thing. Making COM easier to use, especially for C++ developers, is also not a bad thing. But COM+ is not without its share of potential drawbacks.

For one thing, it appears that, like the Microsoft Transaction Server (MTS), COM+ will be available only on Microsoft platforms. This weakens Microsoft's already limited multiplatform COM and DCOM story. While ports to Unix and other operating systems are beginning to appear—from Software AG and other companies—they will support only classic COM, not COM+. Classic COM objects will still interoperate with COM+ objects, but programmers in multiplatform environments will need to learn and use both the old and the new approaches.

Perhaps a more important concern with COM+, however, is the dislocation this change implies. It's very hard to argue that the rate of change in the software indus-



With COM+, the process is much simpler since the C++ compiler uses the COM+ library to create embedded calls and metadata.

try is too slow. Indeed, it's fair to say that most Windows developers have only recently acquired solid knowledge of COM. And while COM+ unquestionably will make it easier to use COM, it also will bring changes in the way objects behave.

Changing a basic part of the infrastructure can create legacy support nightmares, especially for groups building long-living, mission-critical applications. Those customers aren't necessarily interested in the newest, coolest technology. Instead, they want technology they can use to run their businesses effectively.

COM+ will affect core enterprise software like MTS (see "Interceptors Add Object Functionality," page 101), which Microsoft shipped only a year ago. Changing MTS so soon means that the skills necessary to maintain MTS applications built today could be scarce in 10 years. But those MTS-based applications may well still be in use, challenging those programmers responsible for maintaining them. If Microsoft wants to capture the hearts and minds of the enterprise—

and it does—the company must understand that for many users of computing technology, stability matters more than state of the art.

Making It Real

Microsoft announced COM+ in September and says it plans to release the COM+ library in the second half of 1998. But this is only the first step. Using COM+ effectively will require that development tools, such as C++ compilers, change to use the COM+ library. This will take some time. For most of us, COM+ probably won't be a standard part of the tools we use until 1999.

Given that COM+ is so far in the future, Microsoft is encouraging developers to continue using COM today. And since the software giant assures us that COM and COM+ will work together effectively, it appears that investments in COM today won't be a waste. But given how fundamental COM has become to software development on Microsoft platforms, anything that makes using it easier and more effective is unquestionably progress. ■

WHERE TO FIND

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<http://www.microsoft.com>

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Microsoft Internet Explorer 4

Setting any legal disputes aside for the moment, Internet Explorer is poised to be so seamlessly integrated with the Windows UI that you're never sure where the line between your system, the intranet, and the Internet lies. In the features war, IE 4.0 fares well, particularly in how Microsoft has applied eXtensible Markup Language (XML) to its push technology. It's also an early adopter of cascading style sheets and data-bound Web page controls. Microsoft, Redmond, WA; 206-882-8080. <http://www.microsoft.com>

Netscape Communicator 4

This browser may be poised to become your new user interface. Thanks to Netscape, you can now have the same UI on 17 different operating systems, with information being pushed into your desktop from corporate intranets and the public Internet alike using Netscape's standards-based Netcaster push technology. And the Collabra Client dramatically resets what we expect of Internet groupware. Netscape Communications, Mountain View, CA; 650-937-2555. <http://home.netscape.com>

Play Trinity

If you do anything with video, you'll be amazed at what \$4995 can buy you. This live production editor can mix as many as eight video sources, two still stores, and a matte generator in real time at full D1 resolution. This is the future of TV. Play, Rancho Cordova, CA; 916-851-0800. <http://www.play.com>

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Awards of Distinction

Acme Laboratories Acme.Serve

Like the JavaSoft Java Web Server, Acme.Serve is another Java-extensible HTTP server. Except this one is about 1500 lines of code—just enough to deliver a .class file and start up a servlet-applet conversation. Acme Laboratories, Berkeley, CA; no phone number. <http://www.acme.com/java/software/Acme.Serve.Serve.html>

Apple Mac OS 8

The Mac OS just got easier to use: Pop-up tabs for frequently used folders help organize your work, context-sensitive menus help guide you through complex operations, to name a few improvements. And the multithreaded Finder enables you to be copying several files in the background while you launch other apps. Apple Computer, Cupertino, CA; 408-996-1010. <http://www.apple.com>

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Apple PowerBook 3400/240

No, it's not the lightest notebook, nor does it have the biggest screen, but it has a huge hard drive (2 GB, soon to be 4 GB) and long battery life (3 hours of heavy-duty use, according to BYTE's own testing), plus built-in 10Base-T Ethernet and a 33.6-Kbps modem. What these models lack in weight, they make up in brawn: They're the fastest, most powerful notebooks on

lic Web server with hundreds of users each day and never crash. Add the integrated Netscape FastTrack Server, StarOffice Productivity Suite of desktop apps, and integrated NetWare connectivity, and you get a powerful desktop or server. Caldera, Provo, UT; 801-377-7687. <http://www.caldera.com>

Citrix WinFrame 1.7

WinFrame was cool before it was cool to be a thin client. Ver-

screen, 20X CD-ROM, full MPEG-2, Pentium CPU running as fast as 233 MHz, and up to a 5.1-GB disk drive. But would you expect anything less from IBM? IBM Personal Computer Company, Somers, NY; 800-426-2968.

<http://www.us.pc.ibm.com/thinkpad.com>

JavaSoft Java Web Server

You can extend the capabilities of this Java-based HTTP server by writing servlets—Java applets that execute on the server, not on the client. This kind of server application development is going to be a major part of the future of application building. Sun Microsystems, Palo Alto, CA; 415-842-7500. <http://www.javasoft.com>

Marimba Bongo 1.0

As a professional Java development tool, Bongo may lack some of the features of Symantec's Visual Café Pro. But as a Java development tool for the rest of us, it goes a long way toward applying Visual Basic-like ease to Java programming. Marimba, Palo Alto, CA; 415-328-5282. <http://www.marimba.com>

Metrowerks CodeWarrior 11

One of the all-time great development tools for the Mac, but it targets just about any platform you can imagine. The latest release, CodeWarrior 11, tackles C, C++, Object Pascal, and Java. Platform-wise, it supports just about everything from the Palm Pilot to MIPS processors to the BeOS. Metrowerks, Austin, TX; 800-377-5416, 512-305-0400. <http://www.metrowerks.com>

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tion Server wasn't the first Windows NT Web server, but its high performance, ease of use, key management features, client authentication, Active Server Pages, and efficient thread-pool architecture make it one of our most relied upon. Microsoft, Redmond, WA; 206-882-8080. <http://www.microsoft.com>

Microsoft Transaction Server

Server-side components are hot stuff, but how do you get them working together? Microsoft's answer is Transaction Server. Integrated with Windows NT and Internet Information Server, MTS provides an environment for ActiveX components to work together. Microsoft, Redmond, WA; 206-882-8080. <http://www.microsoft.com>

Netscape SuiteSpot Professional Edition 3.1

SuiteSpot, a combination of Enterprise Server, Media Server, Catalog Server, Collabra Server, Messaging Server, Calendar Server, Directory Server, Proxy Server, Certificate Server, and LiveWire Pro, is one of the most complete suites of intranet/Internet/extranet development tools we've seen. Netscape Communications, Mountain View, CA; 650-937-2555. <http://home.netscape.com>

Number Nine Revolution 3D

For video and 2-D graphics, this card is a scorcher. Add good 3-D and you have an excellent all-around card for multimedia production. Number Nine, Lexington, MA; 800-GET-NINE, 781-674-0009. <http://www.nine.com>

Psion Series 5

Amidst all the razzle dazzle about Windows CE devices, Psion released an impressive alternative; the Series 5 boasts



the planet, with PowerPC chips running at up to 240 MHz. Apple Computer, Cupertino, CA; 408-996-1010. <http://www.apple.com>

Borland JBuilder

Database integration, code obfuscation (to make it harder for people to download your code and disassemble it), and a slick, automated user interface make JBuilder a must-have for any serious Java developer. Borland, Scotts Valley, CA; 800-233-2444, 408-431-1000. <http://www.borland.com>

Caldera OpenLinux 1.1

It's no mean feat to run a pub-

sion 2.0 made it cooler by adding dynamic load balancing between CPUs. Citrix Systems, Fort Lauderdale, FL; 954-267-3000. <http://www.citrix.com>

Connectix Virtual PC

Who else but Connectix could whip out a Pentium emulator for the Mac, complete with MMX instructions, PCI bus, and IDE drive emulation? Connectix, San Mateo, CA; 650-571-5100. <http://www.connectix.com>

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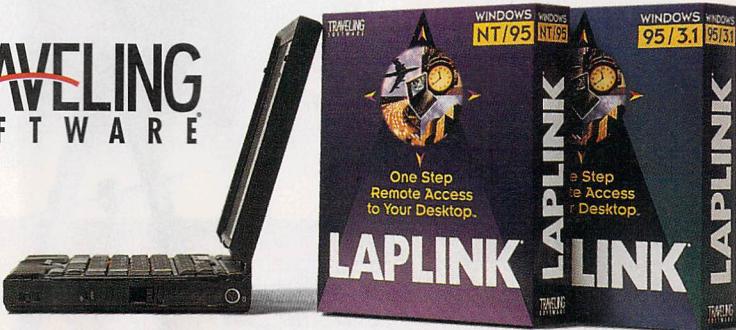
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a keyboard that's well thought out and EPOC, its slick operating system software. Psion Computers, London, U.K.; +44 (0) 171 3174100. <http://www.psion.com>

Sun Java Workshop 2.0

You'd expect a Sun product to support the latest Java Development Kit. And a code profiler wouldn't be too unexpected. But would you also expect it to have an easy-to-use UI? Support for multiple OSes, including Windows 95? It does, plus more. Sun Microsystems, Palo Alto, CA; 800-786-7638, 415-842-7500. <http://www.sun.com/workshop/java>

Sun Microsystems JDK 1.1

With version 1.1, JavaSoft attacked some of the deficiencies critics have cited about previous versions of the Java Development Kit (JDK). This edition brings improved performance and support for printing, digital signatures, and remote method invocation. Sun

Microsystems, Palo Alto, CA; 415-842-7500. <http://www.javasoft.com>

Symantec Visual Café for Java

An excellent visual integrated development environment (IDE) and native database support for Informix, Oracle, and Sybase databases make Visual Café Pro one of our top choices for Java development. Symantec, Cupertino, CA; 408-253-9600. <http://www.symantec.com>

Toshiba Libretto 50 CT

Windows CE and the handheld PC made big splashes recently, but many users realized that CE was maybe a little too Spartan for their needs. At just over a pound and a half and measuring 8.3 x 4.5 x 1.3 inches, the Libretto looks like a heavy Windows CE device. But when you get up close, you see it's running a full version of Windows 95, has a 772-MB disk, and a 75-MHz Pentium. Dock it and you've got a rea-

sonable desktop. Toshiba America, New York, NY; 212-596-0600. <http://www.toshiba.com>

Awards of Merit

Apple PowerBook 2400

Apple's going in the right direction with this one: a 4.4-pound notebook with a nice 800-by-600-pixel screen. It has the PC Card slots pointed to the rear for handily hooking up Ethernet or modem cards to wall sockets, and there's a SCSI port for plugging this road machine into office peripherals. Apple Computer, Cupertino, CA; 408-996-1010. <http://www.apple.com>

Caligari trueSpace 3

If you want to learn how to do 3-D graphics, here's the ticket. Caligari's trueSpace has always been a program that's easy to learn, but with its metaball modeler, inverse kinematics, behaviors, and other professional-level features, it packs a serious wallop as well. With

a \$795 list price, it's hard to beat this package. Caligari, Mountain View, CA; 415-390-9600. <http://www.caligari.com>

Chorus Systems Chorus/Cool ORB

You need Common Object Request Broker Architecture (CORBA) but don't have a lot of space? This mini-ORB will fit for most embedded applications, and it runs under Windows NT and 95, Linux, Solaris, and HP/UX. It's important enough that Sun bought Chorus late this year. Chorus Systems, Campbell, CA; 408-879-4100. <http://www.chorus.com>

Chorus Systems Chorus/Jazz 1

This is a Java-enabled real-time operating system with all the standard Java containers and classes. Chorus Systems, Campbell, CA; 408-879-4100. <http://www.chorus.com>

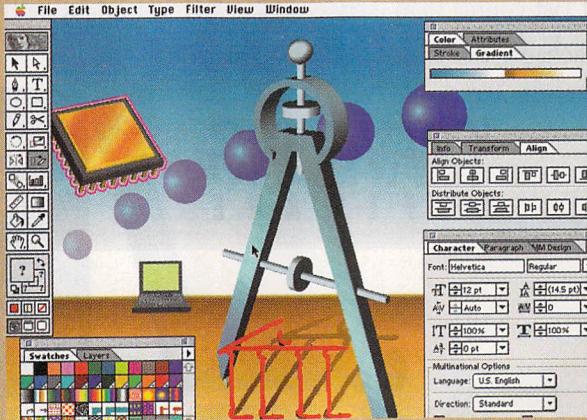
Dynamic Pictures Oxygen 402

HALL OF FAME

Since we published our first Editors' Choice Awards in 1989, we've given over 200 awards. Sometimes our aim is true to the mark—we were among the first to give an award to the VBX, for example—and sometimes our crystal ball becomes clouded (whatever did happen to WingZ?). But of the products we've given kudos, some have truly stood the test of time. These are the recipients of the BYTE Hall of Fame awards.

Adobe Illustrator

Where would the graphics arts community be without this war-horse drawing program? The recipient of many readers' choice awards and editors' choice awards over the years, Illustrator is still the de facto standard for drawing. Adobe Systems, San Jose, California; 408-536-6000. <http://www.adobe.com>



Novell NetWare 3.x

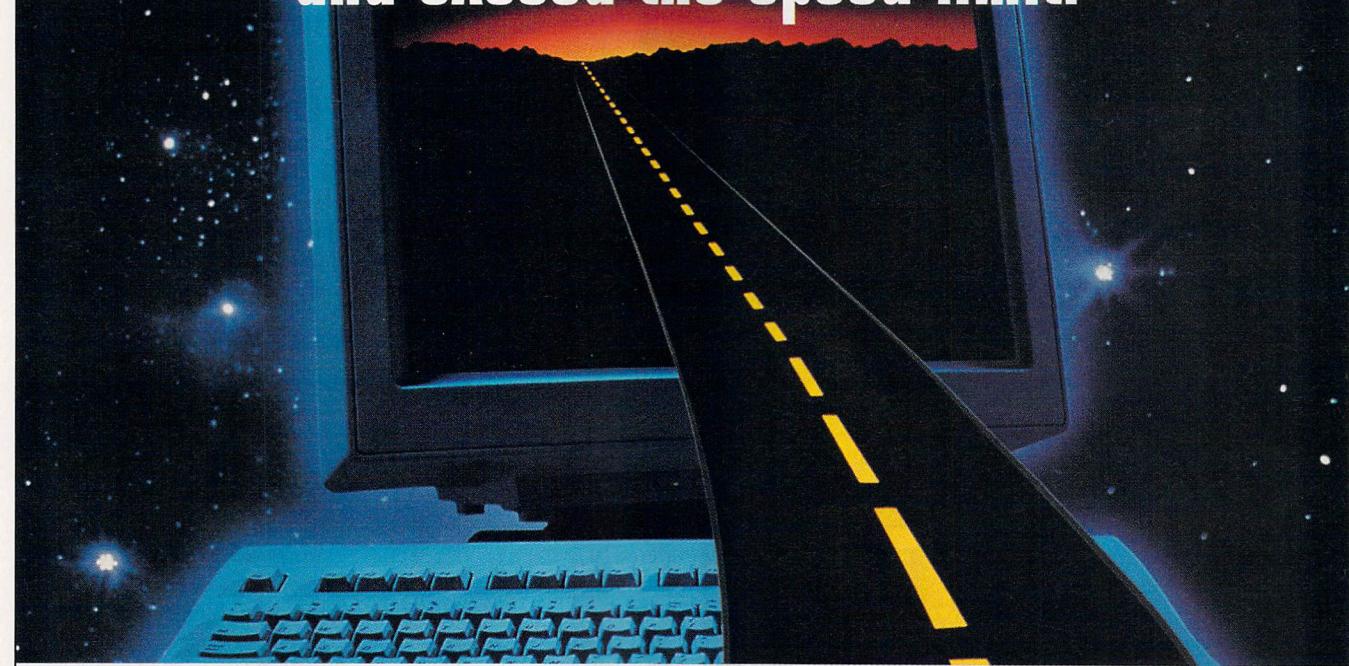
Devoid of a fancy graphical user interface, NetWare 3.x nonetheless became the standard for file and print services. Why? It's fast, well understood, and very reliable. Beyond that, it was the first version of NetWare to support a standard

method for extensibility: the NetWare loadable module (NLM), which enabled a new category of server—the application server. Novell, Provo, UT; 801-429-5508. <http://www.novell.com>

World Wide Web

Tim Berners-Lee probably never thought that people would be talking about the Web as the next television. But this hyperlink-based medium for sharing information, built around the relatively simple standards of HTTP and HTML, has become the way to compute in the 1990s. And the future looks even better, with new protocols and technologies promising to enable yet more types of applications. World Wide Web Consortium. <http://www.w3.org>

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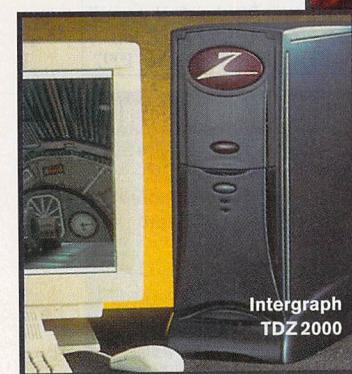
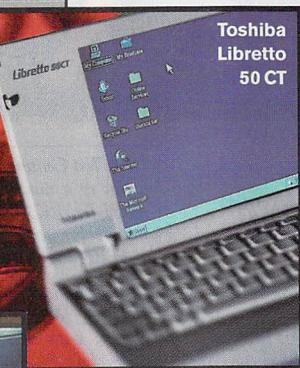
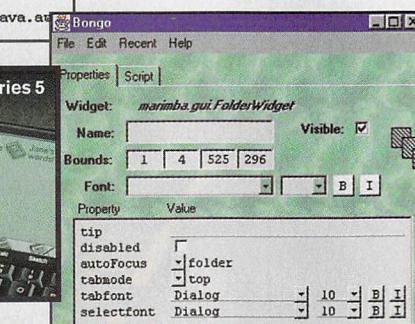
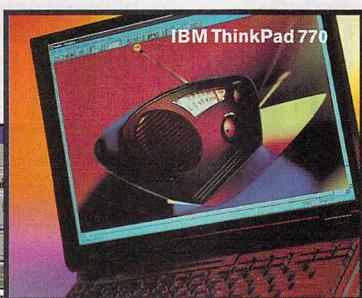
Los Angeles

626/810-0098

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High-end graphics previsualization gets real with this board's real-time texturing, modeling, and lighting. Four processors on the board and a scheme to off-load geometry to the main CPU are what make it happen. Dynamic Pictures, Santa Clara, CA; 408-327-9000.

<http://www.dypic.com>



Epson Stylus Color 800

At first glance, the Epson Stylus Color 800 seems like just another midpriced color inkjet printer in a highly competitive market. What sets it apart is its amazing output resolu-

tion: 1440 by 720 dots per inch in color. This produces high-quality images that clearly surpass most color lasers. Epson, Torrance, CA; 310-782-0770.

<http://www.epson.com>

Iona OrbixWeb

OrbixWeb brings the combination of Java, Web programming, and CORBA into the realm of standard application programming, through both innovative technology and the relatively low price of \$799. Iona Technologies, Dublin, Ireland; U.S.: 1-800-672-4948; Europe: +353-1 662-5255; Asia Pacific: +61-8-9288-4000.

<http://www.iona.com>

JASC PaintShop Pro 4

The little shareware app that could—do anything with graphics, that is. Version 4 added support for new graphics types and also improved the user interface substantially. JASC, Minnetonka, MN; 612-930-9800.

<http://www.jasc.com>

Kinetix 3D Studio Max 2

This may be the biggest 3-D news this year. With literally a thousand new features, this already powerful 3-D application brings NURBS modeling, dynamics, selective ray tracing, extensive material controls, and much more to the table for \$3495. Kinetix, San Francisco, CA; 415-547-2000.

<http://www.ktx.com>

Macromedia Director 6

The leading multimedia authoring program continues to get better. Version 6 adds capability (it manages more elements better) and usability (like drag-and-drop behaviors). Macromedia, San Francisco, CA; 415-252-2000.

<http://www.macromedia.com>

Microsoft NetMeeting 2.0

Talk to me. Share your innermost data and applications. Do it for free. BYTE editors have used NetMeeting to "talk" to each other out-of-band during conference calls, sharing pictures, applications, and off-line comments. Microsoft, Redmond, WA; 206-882-8080.

<http://www.microsoft.com>

Newmonics PERC

Real-time Java? Are you crazy? Maybe, but Newmonics has done a lot of down-and-dirty research into garbage collection and the headaches of trying to apply Java to real-time systems. Newmonics, Ames, IA; 515-296-0897.

<http://www.newmonics.com>

Seagate Cheetah ST34501

10,000 rpm. Speed like that will get you down to seek times of about 7.5 ms. It'll also boost the heat something fierce. But not with the Cheetah: Seagate engineered it to dissipate the heat of the more powerful hard disk assembly. 9.1 GB of Fibre Channel storage never looked better. Seagate Technology, Scotts Valley, CA; 408-438-8111.

<http://www.seagate.com>

Sonic Foundry Sound Forge 4

Finally, decent affordable (about \$300) audio manipulation on the PC platform. Tons of power and laid out very well. Sonic Foundry, Madison, WI; 608-256-3133.

<http://www.sonicfoundry.com>

Wall Data Salsa 2.2

Semantic object modeling. It sounds like something you'd write about for a Ph.D thesis. Actually, it is, but it's also a superior way to build database applications quickly. Version 2.2 of Salsa improves previous versions' database access. Wall Data, Kirkland, WA; 206-814-9255.

<http://www.walldata.com>

Web Project



The Value of Free Software

Free software packages power much of the Internet because they're not just free—they also work extremely well.

In August, over 1000 people gathered for the first-ever Perl Conference. Quite a turnout for a freeware product! Of course, Perl's lack of a price tag is not the main reason for its popularity. Folks like me use it because when you need to solve certain kinds of problems, there's nothing else like Perl—at any price.

The Linux OS and the Apache Web server enjoy similar reputations, and now I can understand why. Neither of these packages has failed in over a year of continuous use on the BYTE conference server. During that same period, our main Web server, running Windows NT 4.0 and Internet Information Server (IIS) 3.0, has suffered a few software failures. Now the NT server handles about 7500 users per day while the Linux box supports only about 1000, so I can't make an apples-to-apples comparison.

Would my Linux/Apache/INND server handle 15 times more users with equal aplomb? I won't know unless I try, but clearly these freeware packages work very well. It's no accident that Apache owns a commanding share of the world's Web-server pie (see the graph at right).

Of course, the very fabric of the Internet is woven with free software. Without a trio of freeware stalwarts—Berkeley Internet Name Daemon (BIND), sendmail, and InterNet News (INN)—there would be no Domain Name System (DNS), Internet mail, or Usenet conferencing.

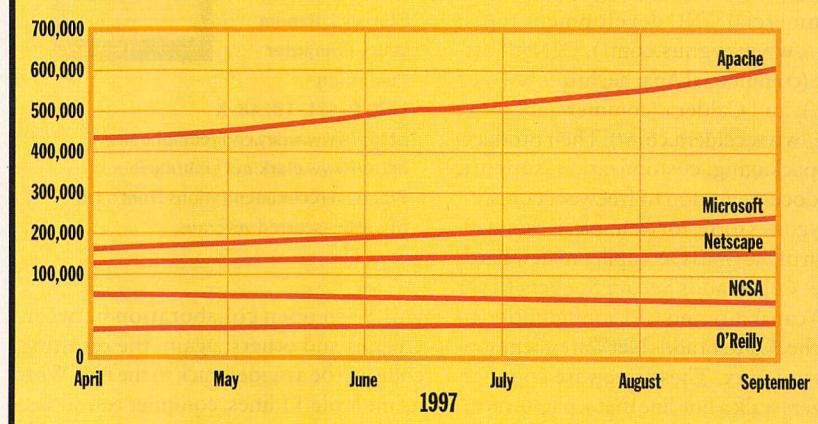
The Cathedral and the Bazaar

What's going on here? How can free software possibly compete with commercial stuff? Eric Raymond thinks he can explain the apparent paradox. In the final keynote speech at the Perl Conference,

Raymond elaborated on his popular essay "The Cathedral and the Bazaar" (<http://www.ccil.org/~esr/writings/cathedral.html>). Practitioners of the cathedral style of software development, according to Raymond, work in small groups, behind

the scenes, to produce infrequent major releases that are claimed to be definitive. Meanwhile, practitioners of the bazaar style—in particular, the Linux developer community—form a large, loose-knit collective that works in a very public way to create a stream of incremental releases that are always understood to be in flux.

Top Servers



Apache owns a commanding share of the world's Web-server market.

closed doors, to produce infrequent major releases that are claimed to be definitive. Meanwhile, practitioners of the bazaar style—in particular, the Linux developer community—form a large, loose-knit collective that works in a very public way to create a stream of incremental releases that are always understood to be in flux.

Who are the cathedral-dwellers? Raymond fingers the Free Software Foundation (FSF)—a terrible irony, given that both the philosophy and the GNU development tools pioneered by FSF's Richard Stallman are the foundation stones upon which Linux is built. Other exemplars

all else. Linus Torvalds is not only an ace kernel hacker, but, more important, a brilliant leader who knows how to harness and satisfy that craving.

Management style alone cannot account for the huge success of Linux, however. Not all freeware projects work the way Linux does; conversely, some commercial projects do. What makes Linux as solid as it has become is the wide distribution and ongoing study of its source code. "Given enough eyeballs," explains Raymond, "all bugs are shallow." That's the most powerful argument in favor of free software: Anyone can inspect it, and anyone can improve it.

continued

But I Just Want to *Use* the Thing!

Clearly, most people don't have the time, inclination, or ability to study—much less comprehend and modify—the internal workings of their OSes, Web servers, or programming languages. We just want to install them easily and have them work as advertised. We want documentation that's helpful. If something fails, we want to call for, and receive, timely assistance.

Freeware developers aren't required to provide this kind of service and support. Corporate users therefore regard free software with a healthy dose of suspicion. In theory, commercial developers are obliged to fix what's broken. In practice, freeware developers sometimes respond as fast or faster than their commercial counterparts. But there's no guarantee, so this is a tough argument to pitch to a CIO.

Enter commercial freeware, a seemingly paradoxical business model practiced by companies such as Cygnus Solutions (commercial GNU development tools; <http://www.cygnus.com/>), C2Net Software (commercial Apache; <http://www.c2.org/>), and Caldera (commercial Linux; <http://www.caldera.com/>). Their products add packaging, customization, support, and documentation to freeware cores.

Cygnus's forte, for example, is the adaptation of the GNU C compiler to new hardware. C2Net adds Secure Sockets Layer (SSL) capability and GUI configuration to Apache. Caldera adds NetWare client support to Linux. These freeware commercializers walk a fine line that separates symbiosis from exploitation.

Enlightened Self-Interest

In 1987, Michael Tiemann and others founded Cygnus, seeing an opportunity to target the GNU C compiler to RISC processors. Thus was born gcc2, a gcc offshoot that was still made freely available under the terms of the GNU General Public License (<http://www.fsf.org/copyleft/gpl.html>) but whose development was still overseen by Cygnus more than by the FSF.

Cygnus currently sees a new opportunity to adapt gcc to the needs of the embedded-systems market. "Now gcc knows a lot about RISC pipelines," says Tiemann, "but it doesn't know boo about DSPs."

So, the company is hosting another offshoot project, egcs (<http://www.cygnus.com/egcs/>). Again, Cygnus's staff will spearhead the effort; again, the project

TOOLWATCH

DAF 2.0

\$95 for one server

Philippe Tenenhaus

<http://daf.simplenet.com/>

DAF, or Dynamic Authentication Filter, is an ISAPI filter that maps thousands of Web users onto one or several NT user names. If you're running a sizable protected site using IIS, you need a tool like this. Ultimately all IIS security refers to NT security, but it would be crazy to create an NT account for each of thousands of users.

BOOKNOTE

Web Security Sourcebook

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Daniel Geer, and
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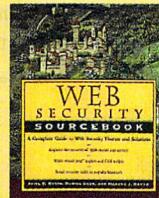
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Practical recommendations from a trio of battle-scarred veterans.



will be an open collaboration between Cygnus and others; again, the resulting code will be assigned back to the FSF. With its multiple T1 lines, compiler test suites, test machines, source-control system, and, of course, its own team of ace compiler hackers, Cygnus hopes to focus the largest possible pool of talent on the egcs project.

The Apache project runs differently than most freeware projects. Perl, for example, continues to evolve under the watchful eye of its creator, Larry Wall. Likewise, Linux does the same under Linus Torvalds. But Apache is governed by 13 co-equal developers who share permission to commit changes to the Apache source tree.

Several of these developers also run businesses that depend on Apache. Brian Behlendorf is CTO of Organic Online (<http://www.organic.com/>), a Web consultancy that builds sites for companies such as McDonald's and Colgate. Relying on Apache wherever possible, Organic leverages not only the core group's knowledge of the product but also that of another

10 to 15 active developers and of several hundred others who have at one time or another submitted patches.

Another member of the core group is Sameer Parekh, president of C2Net Software. His Apache-based product Stronghold (which has now merged with another SSL-capable Apache variant called Sioux [see "Digital IDs," March BYTE]) incorporates Eric Young's SSleay, itself a free-ware product.

Young and his partner, Tim Hudson, now work for C2Net, where they've added support for SSL version 3 to SSleay. C2Net could have chosen to reserve rights to the SSL-V3-enhanced SSleay, but it has given it back to Young—and thence to the world.

This kind of enlightened self-interest can, under the right circumstances, create a successful symbiosis of freeware and commercial interests. "We will keep our value-adds separate from the core," says Parekh. In Stronghold 2.1, these will include GUI administration, embedded scripting, a search engine, and hooks into Xcert Software's (<http://www.xcert.com/>) Sentry CA, a certificate-authority package.

Caldera marketing chief Ransom Love tells a similar tale. One of the company's aims has been to attract commercial Unix applications to the Unix platform, and these include Netscape's Navigator and FastTrack server, along with WordPerfect. Caldera is now working to integrate Java into Linux and to use Java to create a complete GUI-based administration tool for Linux. The Java integration requires the licensing of software from Sun—something the Linux community can't do, but a company such as Caldera can.

Caldera plans to reserve rights to its Java-integrated Linux. But it will contribute its Java-based GUI administration tool to the freeware realm. It's a smart move. Unix has always desperately needed a universal configurator that could be standard across all Unix species and that could evolve rapidly. Enlightened self-interest again. "When Ray Noorda started Caldera," says Love, "the philosophy was to grow the pie." If this project captures the interest of the freeware community, it will help grow the Linux pie.

A Dose of Reality

So what's wrong with this picture? There are, to be sure, some blurry areas. Building quality software is hard work that can command a princely wage in the commercial world. Who rewards the produc-



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ers of freeware? Answers include the following:

1 Theirselves. For many developers, a freeware project is an all-consuming hobby that can literally be its own reward.

2 Their peers. As Eric Raymond points out, peer recognition is a powerful incentive in the hacker culture—often the most powerful.

3 Their users. Freeware developers can enjoy a kind of direct and immediate interaction with their users, a social benefit that is often unavailable in commercial settings.

4 Their employers. Freeware projects often spring from efforts to solve business problems. Perl, for example, was Larry Wall's solution to his employer's distributed-network-management problem. To the extent that companies perceive software thus created as mission-critical, freeware projects can earn official status.

Of course, it's not a freeware project unless the employer believes that the value of keeping the software free, measured in terms of contributed development, outweighs the cost of keeping the software free, measured in terms of the competitive advantage surrendered by doing so. Behlendorf says that he occasionally has to re-

mind Organic's board of directors that an open Apache is worth more to the company than a proprietary one would be. Clearly, this is an extremely tricky matter that will be resolved by different companies in different ways for different reasons.

Apart from all the well-known success stories, does the freeware model reveal any deep principles of software engineering that can and should be applied more broadly? It's unclear. Even the strongest freeware advocates admit that only certain kinds of projects inspire the necessary passion. There's no shortage of would-be compiler and OS-kernel hackers, but few are clamoring to write installation and configuration tools, word processors, accounting packages, or documentation.

Rob Kolstad, president of Berkeley Software Design, isn't convinced that there's more to free software than meets the eye. His company's product, BSD/OS, derives from the free Berkeley Unix, but BSD/OS isn't freeware. Kolstad and his team of 19 engineers have crafted a tightly integrated system for ISPs and corporate customers. "If you buy Linux from Caldera and the rest," says Kolstad, "they're not in there fixing drivers and protocols; they just hold their cups over the dam and wait." BSDI,

he adds, commits to service, support, and integration that don't depend on a volatile freeware community.

What about Eric Raymond's assertion that all bugs are shallow given enough eyeballs? Kolstad counters that it's not the number of eyeballs that matters; it's the quality of the brains behind them. That said, Kolstad doesn't deny the superior quality and utility of many freeware packages. He thinks every computer-science student should be required to build some useful package, acquire hundreds of users, support it, refine it, and then, finally, "as a parting gift to the world, release it."

Recipe for a Good Freeware Project

Every freeware project is different, but successful ones are often characterized by the following three qualities:

1 A personable leader. It's no accident that Larry Wall and Linus Torvalds are, by all accounts, immensely likeable. You can't make freeware developers do the necessary hard work; you can only inspire them to want to. That takes people skills of the same high order as the requisite technical skills.

2 A modular design. The core of any complex software system won't necessarily succumb to the "many eyeballs" approach. But a strong plug-in interface can enable many contributors to play in the game. Linux, Perl, and Apache all exemplify this core-and-plug-in architecture. Consequently, lively development communities are able to contribute a rich and growing assortment of Linux device drivers and Perl and Apache modules.

3 Broad appeal. The software should solve a general problem that lots of people care about.

Everyone owes a huge debt of gratitude to the many freeware packages without which there would never have been an Internet—and to Richard Stallman, without whom there might never have been a freeware culture. Are there more projects like Apache, Perl, INN, and Linux ready to take wing? I hope so.

To test the waters, I've released ByteCal (see "Persistent Java," August BYTE) as freeware, along with documentation that invites users to extend it in several ways. We'll see what happens. ■

Jon Udell is BYTE's executive editor for new media. You can reach him by sending e-mail to jon@byte.com.

Vital BYTE-Site Freeware

Acme.Serve (<http://www.acme.com/java/>) A Java-based Web server; Jef Poskanzer's Acme.Serve hosts our servlets, including ByteCal and Polls.

Apache (<http://www.apache.org/>) A Web server; serves the Web view of BYTE's conferencing system.

EMACS (<http://www.fsf.org/>) A text editor; without Richard Stallman's venerable EMACS, Unix would be useless to me.

Excite (<http://www.excite.com/navigate/>) A search engine; Excite's unique query-by-example enables open-ended searches.

Hypermail (<http://www.eit.com/hypermail/>) A mail-to-Web converter. Kevin Hughes contributed this invaluable tool to the Net; we use it for several internal applications.

INN (<http://www.isc.org/>) An NNTP server; Rich Salz created the engine that powers both the Web and news halves of our conferencing system.

Linux (<http://www.linux.org/>) An OS; actually, we use Caldera's Linux, which isn't freeware, but it would seem unfair not to mention Linux in this context.

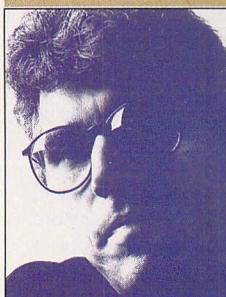
MHonArc (<http://www.oac.uci.edu/indiv/ehood/mhonarc.html>) A mail-to-Web converter. Earl Hood wrote this Perl suite to transform RFC822 messages into Web pages. It supports the Web view of our NNTP discussions.

Perl (<http://www.perl.com/>) A programming language. Larry Wall's brainchild is the glue that binds together most everything on our site: search, forms processing, log analysis, and much more.

SWISH (<http://www.eit.com/software/swish/>) A search engine; Another Kevin Hughes contribution, SWISH complements Excite's useful fuzziness with a more literal search capability.

Win32::Internet (<http://www.perl.com/CPAN-local/>) A Perl Web-spidering module. Aldo Calpini's WinInet enabled my associate Dave Rowell to write a really useful automated site monitor.

Win32::ODBC (<http://www.perl.com/CPAN-local/>) A Perl database module. Dave Roth's ODBC module enables me to use Perl to manage and analyze a 1.6-million-user database.



Javatalk

Poet Goes Java

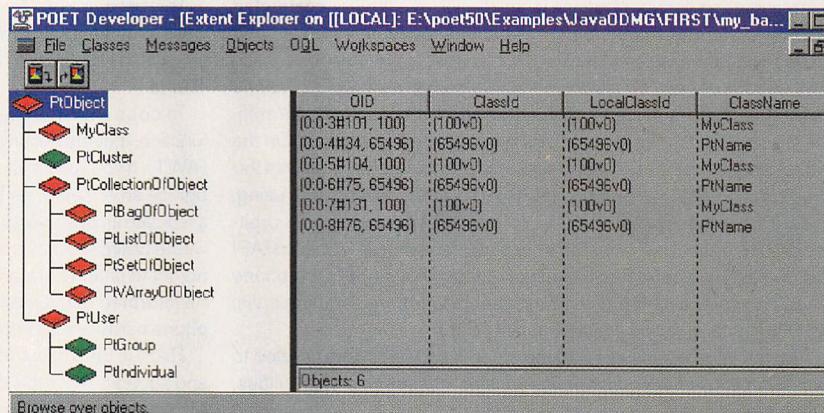
An OODBMS from the C++ world takes the natural plunge into Java.

Thanks to an ability to quickly store and retrieve complex objects, object databases are well suited for Web-oriented applications. Several object-oriented databases and persistent-object storage systems have appeared for Java, and this column marks the beginning of a series of reviews of them.

A few years ago, I reviewed Poet, a promising C++-based object-oriented database from a company of the same name (see "Poet in Motion," May 1994 BYTE). Its latest product is the Poet 5.0 Object Server Suite, which includes an object server; Software Development Kits (SDKs) for ActiveX, Java, and C++; Web Factory; and SQL Object Factory. The object server is language-independent—it merely manages requests from a Poet application, which could be written in ActiveX, C++, or Java (which means that a given installation could involve applications written in either language "talking" to the same server).

The server includes facilities to handle administrative chores such as database management, back up and restore, user-access management, and so on. The SDKs are where you build Poet applications. They automate compiles and links, and also let you go through the contents of a database, viewing object structures as well as object data. Web Factory lets your application generate Web pages dynamically, and SQL Object Factory lets you program using the Poet API and transparently access data in a Poet or relational database or both. In this article, I focus on the Poet 5.0 Java SDK and server.

A Poet database consists of two or three storage areas (each storage area becomes a file on the disk). The first is the dictionary, which carries the class-structure def-



Poet's database browser looks much like an object browser. You can visually navigate through the classes and objects in a database.

initions for objects in the database. The second area—the real database—holds the persistent objects themselves. These two areas work in concert. The database server must have the dictionary to understand the structure of the objects stored in the database. Finally, a database may have one or more indexes associated with it. These are kept in a third area.

Because the structure information for the persistent objects is kept in the dictionary, modifying the dictionary after you have stored data is problematic. How does the system know how to read an object if its structure definition has been altered? Suppose, for example, after you have stored several objects in a database, you alter the class definition for those objects (in the dictionary) to add or remove a member. Poet handles this situation by maintaining multiple class versions in the dictionary.

In other words, Poet knows how to read the "old" objects as well as the "new" ones. Furthermore, when your application reads an old object, Poet automati-

cally converts it to the new format. When you save that old object into the database, its structure is automatically updated.

Poet is compliant with release 2.0 of a standard from the Object Database Management Group (ODMG) that helps ensure the portability of database applications across platforms and products. This compliance means a great many things, including the fact that Poet supports embedded and ad hoc queries in the object query language (OQL). I invite you to visit the Poet Web site (<http://www.poet.com>) for details. An important part of ODMG compliance is that Poet uses *persistence by reachability*. That means that object A becomes persistent if it is referenced by persistent object B.

For concurrency and integrity management, Poet supports powerful transaction capabilities. Transactions can be nested, which allows you to create *commit levels*. This allows you to create a situation in which an enclosing transaction commits only if all its component transactions were successful. If one of the

Java, Come Hear I Need You

JTAPI, the Java Telephony API, is part of a series of multimedia APIs JavaSoft is rolling out this year. At the time of this writing, JTAPI was at version 1.1. The company was expecting to release version 1.2 within a month.

JTAPI is actually a collection of Java APIs for telephony support. In particular, JTAPI can deal with either first- or third-party telephony applications. (An example of a first-party application is a desktop system equipped with a multifunction telephony card. An example of a third-party application is a server system controlling a network of phones, faxes, and modems. JTAPI is built in such a way that it accommodates either application.)

It's important to recognize that JavaSoft did not solely author JTAPI. According to Vicki Shipkowitz, senior product marketing manager for Java media and communications technologies, JTAPI was constructed with the aid of organizations such as Lucent, Nortel, Intel, Novell, and IBM. The goal was to create a TAPI that was simultaneously extensible and uncomplicated. This involved walking a narrow line. On the one hand, JavaSoft wanted enough functionality in the API so that it sufficiently modeled those applications it is supposed to support. On the other hand, too much completeness leads to complexity; and with too much complexity, the result is an API that no one is interested in using.

JTAPI's architecture is that of a collection of extension APIs orbiting around a core package. The core package defines the basic JTAPI *call model* (the abstract collection of objects that model a telephone call). The core also supplies foundational functions: placing calls, answering calls, dropping calls, and so forth.

The package extensions add the objects and behaviors needed to either implement specific applications or add specific capabilities. There are six extension packages in version 1.1:

- Call control, which adds such capabilities as putting a call on hold, transferring a call, and conferencing.
- Call center, which provides routing and automated call distribution as used in large call centers.
- Media, which provides access to media streams, such as DTMF and non-DTMF detection.
- Phone, which provides control of the actual phone hardware.
- Private data, which allows the application to communicate directly with the phone-switch hardware.

- Capabilities, which is really a query API that lets an application determine the capabilities of a given system.

JTAPI's call model is the edifice on which reside all the extension packages. The call model is a collection of abstract objects that are defined as interfaces in the core package itself. Key objects within the model are the provider (which provides the actual telephony service) and the call object. Associated with each call object are zero or more connection objects, each of which acts as a link between a call object and an address object (e.g., a phone number). Lastly, the telephone object models the actual phone hardware, and the telephone connection object models the relationship between a call and a physical endpoint.

The behavior of a telephone system is decidedly asynchronous. Calls originate and arrive at unanticipated times. It is therefore important that the application have some means of dealing with unpredictable events.

To cope with this asynchrony, JTAPI defines observer objects. In function, they are not unlike the listeners of the Abstract Window Toolkit (AWT). If you're familiar with Windows programming, you might recognize an observer as being a kind of callback. An application can associate an observer to an object (e.g., a call object), and the observer will be called whenever an event takes place that causes the observed object to change state. In this way, the "upper-level" application can be informed of events from below—where the control of the actual phone hardware is taking place.

JTAPI is meant to address a wide range of telephony applications and accomplishes this thanks largely to its object-oriented roots. The architecture of a core package supporting various extension packages lets developers extend the support in whatever direction their application demands, without breaking the "spirit" of JTAPI.

However, what we call telephony applications is a rapidly expanding sphere. Bill Gogesch, a technical staff member at JavaSoft, admits that JTAPI probably doesn't have all that is required (or, perhaps, has more than is required) to support, for example, mobile phones. JavaSoft recognizes that mobile telephony is a unique enough application that it would be best served by its own API. For this reason, you can expect to see a version of the TAPI for mobile phones that will complement JTAPI in the near future.

enclosed transactions failed, the application can abort the outer transaction and return the database to its previous consistent state. You can build more elaborate transactions using the checkpoint feature.

A checkpoint acts as a kind of internal commit. In other words, if, in the midst of a transaction, an application issues a checkpoint call, all modifications to that

point are committed. This is useful when a transaction involves large amounts of data and a single final commit would result in a storm of I/O to the database. Internal checkpoints let you throttle the flow of data into the database.

Locks in the Poet system can be either implicit or explicit. Implicit locks are automatically placed on objects that your application reads or modifies in the database. Explicit locks come in four flavors: read, update, write, and delete. Each has its own interaction characteristics.

For example, a read lock lets other database users only read the locked object (they cannot modify or delete the object). Similarly, a delete lock assures that no other user attempts to read or modify the locked object. For finer locking control, the under-

lying Poet engine recognizes up to six lock levels. Your application can apply these lock levels if the four standard lock levels are for some reason insufficient.

The Poet 5.0 Java SDK is available for Windows 95 or NT for \$1500 (Poet sells each SDK separately). I tested the NT version, which was in the early stages of release (the manual was available only in Acrobat Reader format). Still, if the final product is as good as its C++ ancestor, Poet should be a powerful, easy-to-use persistent-object storage system worth your consideration. **B**

Rick Grehan is a senior editor at Computer Design magazine and coauthor of The Client/Server Toolkit (NobleNet, 1996). You can contact him at rickg@pennwell.com.

PRODUCT INFORMATION

Object server (NT version): \$5000	Poet Software San Mateo, CA 800-950-8845
Java SDK: \$1500	650-286-4640
Run-time client: \$140 each	fax: 650-286-4630
SQL Object Factory: \$10,000	info@poet.com
Web Factory: \$1500	http://www.poet.com

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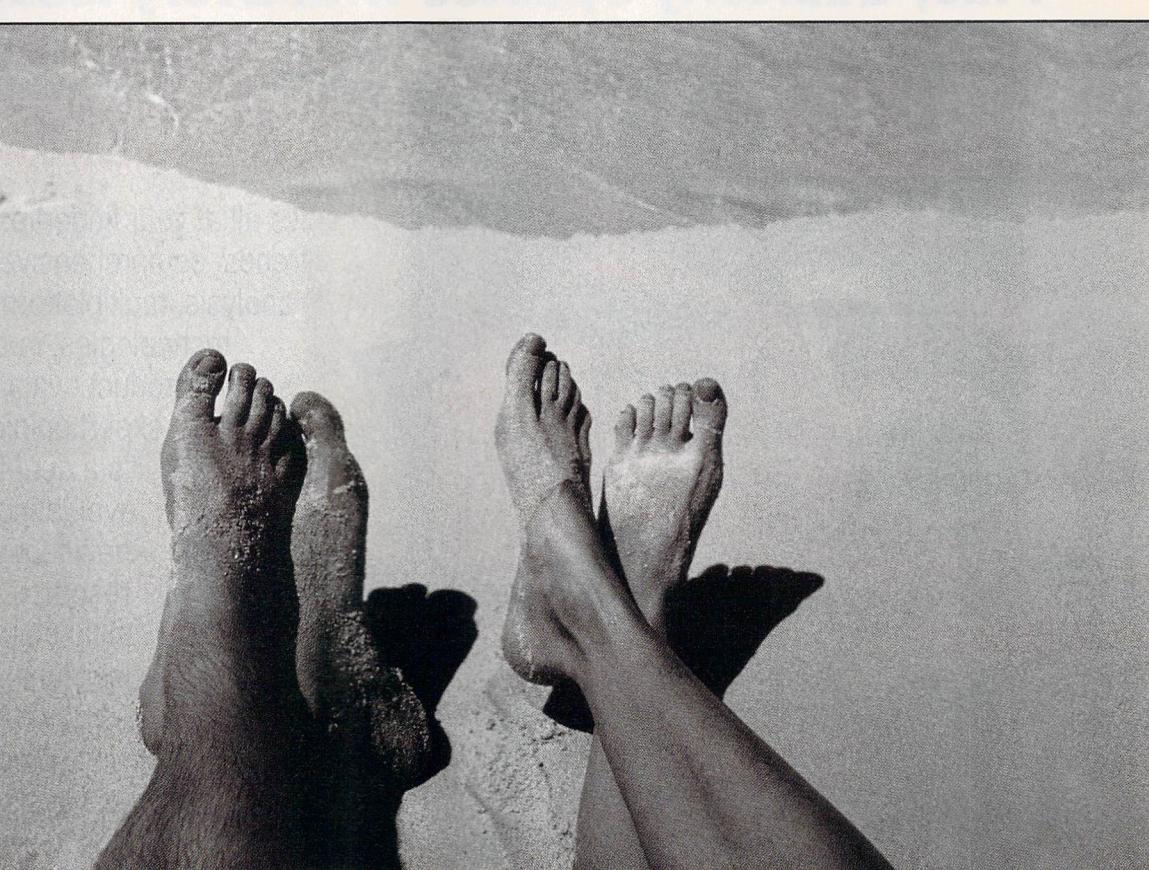


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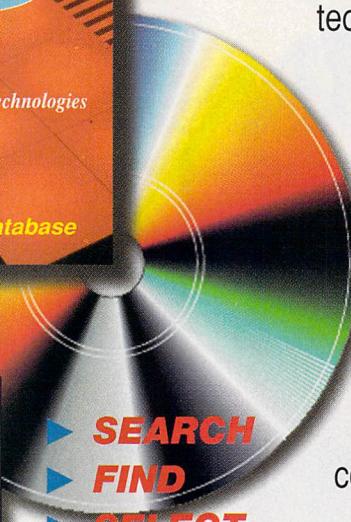
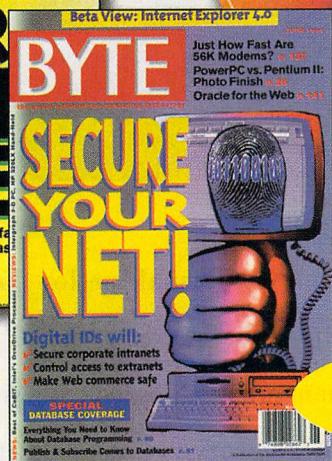
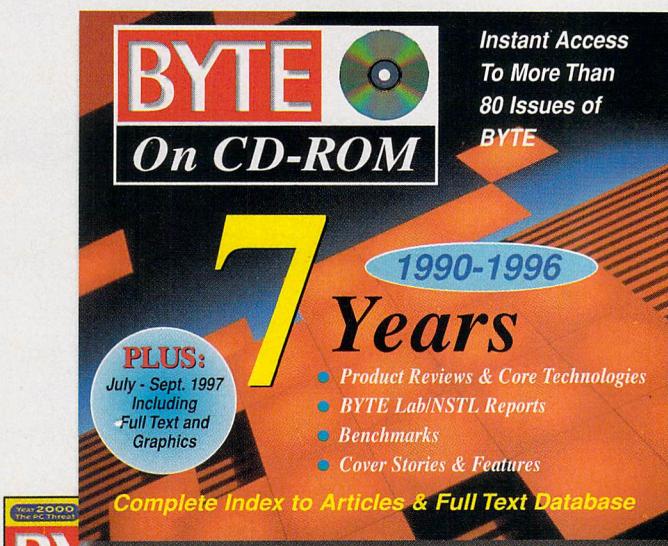
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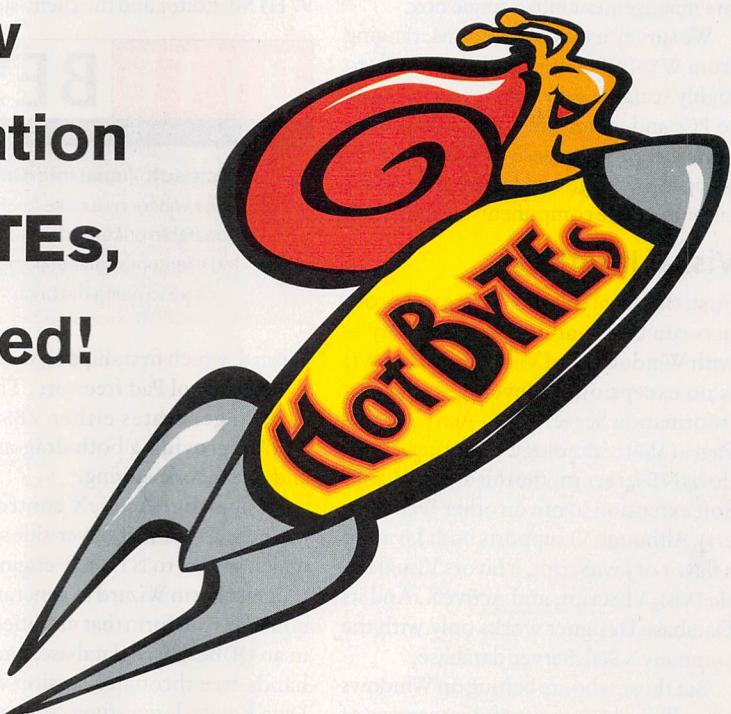
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Toolkits for Building Web Applications

The most popular application for creating and maintaining Web sites comes free on every Windows machine. It's NotePad—the simple text editor that lets you enter raw HTML. But the evolution that occurred from text editors to word processors to desktop publishing programs is mirrored in the rapid growth of Web application-development tools. A variety of strategies are emerging to combine page authoring, application development, and site management into a single box.

We survey a mix of solutions, ranging from WYSIWYG drag-and-drop tools to highly scalable suites that speak fluently to PCs and mainframes alike. The common thread is the desire to leverage existing knowledge and legacy code while embracing the component-based future.

Visual InterDev

First, the usual caveats: Microsoft products run best—and sometimes only—with Windows, and Visual InterDev (VI) is no exception. VI leverages Internet Information Server's (IIS) Active Server Pages (ASP) technology, requiring a Windows NT server (or the third-party ChiliSoft extension to run on other Web servers). Although VI supports both Java and a flavor of JavaScript, it favors Visual Basic (VB), VBScript, and ActiveX. And its Database Designer works only with the company's SQL Server database.

But those who are betting on Windows NT will find VI a powerful integrator of the industry-leading Microsoft tool set. The program's integrated development environment (IDE) combines the look and feel of Office 97 with the functionality of Visual C++ and Visual J++.

Like VB 5.0 and Internet Explorer, VI is an Active Document container, letting developers work with Excel, Word, and other ActiveDoc files without leaving the IDE. The program comes with Image Composer, Music Producer, and Media Manager to help massage content, but you can configure the IDE to launch a favorite application, such as Photoshop, by double-clicking on a designated file type or using the Open With command.

VI includes a version of the FrontPage 97 HTML Editor and the client-side Script

Want to construct and maintain Web sites and Web-based applications? We look at seven tools ready to help you.
By Steve Gillmor

automatically generated, although you need to do some manual editing to insert appropriate database variables.

When a user requests the resulting URL, IIS's ASP engine processes server-side code, initiates a user session and a dialogue with the back-end database, and then returns dynamic output as text and HTML. Proprietary source code remains on the server.

You can preview your work within the IDE via the Internet Explorer ActiveX control or launch a browser. The Data View lets you manage multiple database connections, right-clicking to view table definitions, field types, key structures, and stored procedures. The Database Designer provides Access-like tools that generate Data Definition Language (DDL) commands to design and create SQL Server tables and database diagrams.

For a bird's-eye perspective, switch to Link View's iconic layout of your site. Broken links are indicated in red, and you can filter elements by executables; HTML; multimedia; and internal, external, primary, and secondary links. If you rename or move a file, VI automatically repairs references. Microsoft's Visual SourceSafe can be integrated for check-in/check-out and version control, and FrontPage users can work with VI developers.

HAHTsite

HAHT Software's HAHTsite 3.0 strives to be the best of all worlds, bridging multiple platforms, Web servers, databases, APIs, and browsers. If you like VB and the Visual Studio IDE, you'll be up and running in no time with HAHTsite's VB-compatible HAHTtalk Basic and the Web Project Explorer. Plus, you can use HAHT-

BYTE BEST
WEB TOOL KITS

Microsoft Visual InterDev
is the winner by a nose for its unbeatable price/performance and a features set that comes close to being the best.

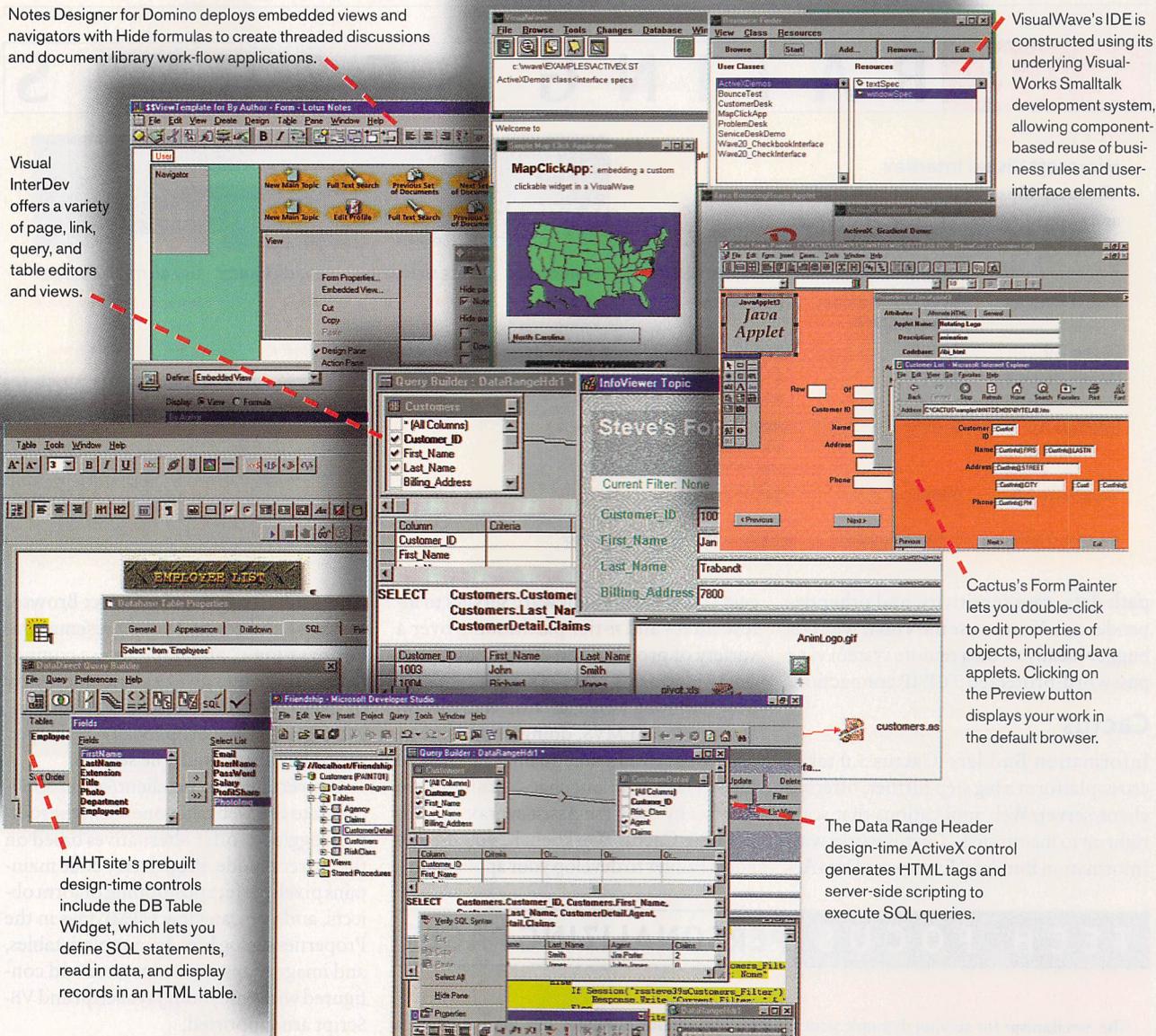
Wizard, which first shipped with the ActiveX Control Pad freeware. The Script Wizard generates either VBScript or JScript, providing both drag-and-drop and direct code editing.

Design-time ActiveX controls automate the creation of server-side scripting, which speaks to NT's ASP engine. I used the Data Form Wizard to generate a data-bound HTML form that modifies records in an ODBC-based database, and I sailed hands-free through a session with two Data Range design-time controls.

The Data Range Header control launches the Query Designer, giving you a drag-and-drop tool for building SQL statements against ODBC databases. The necessary Active Server scripting is

Notes Designer for Domino deploys embedded views and navigators with Hide formulas to create threaded discussions and document library work-flow applications.

Visual InterDev offers a variety of page, link, query, and table editors and views.



This collage of screen shots shows off the diversity of approaches that these toolkits take, as well as the natively graphical nature of the Web.

talk Basic to manipulate and create instances of any Java object class.

The multiprocessing, multithreaded Application Server performs much the same role as Microsoft's IIS ASP engine, intercepting calls to compiled application code and dynamically generating HTML pages. The HAHTsite server uses cookies and state IDs, inserting the client browser's IP address into the state ID for added security.

HAHTsite supports Microsoft's DAO database object model, plus native access to Oracle7, Microsoft SQL Server, Sybase SQL Server, and Informix data stores. The HAHTsite Connection Manager lets every element of a project share a single log-in connection to a database.

The HAHTsite IDE provides a suite of form controls—text areas, buttons, checkboxes, radio buttons, listboxes, and text and combo boxes—and the DataSet control, which binds a form's controls to database tables and provides Insert, Update, Delete, Query, Requery, Clear, and Move actions. The Form Wizard prompts you to select a table or provide a SQL query and specify fields, controls, buttons, and layout; it then generates a database-bound HTML form. Other wizards include report generators, plus a visual click-and-drag HTML frame-creation tool.

HAHTsite's Widget design-, file-save-, and run-time controls can be authored in HAHTalk Basic with the help of a wizard

and the built-in SDK, or you can use pre-built widgets to add Java applets, ActiveX controls, auto-updating link-navigation bars, and mail-to handlers to your pages. Setting text box properties generates JavaScript field-validation code. Portions of pages can be saved as Clips in the Web Project Explorer, and you can drag pages into the HAHTsite image-map editor to generate client- and server-side map files.

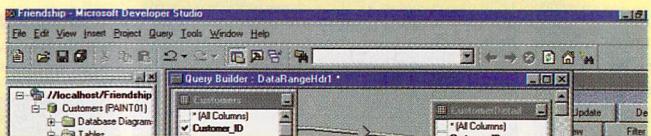
HAHTsite repairs broken links, compiles code into machine-independent p-code, and transfers updates to one or many servers via file copy, FTP, or HTTP. The program manages differences between Web servers and OSes, using preconfigured site definitions to handle file extensions,

LAB RATING RESULTS

BEST OVERALL

Microsoft Visual InterDev

With a terrific set of well-implemented features and a bargain price, VI is our clear winner.



	PRICE PER DEVELOPER	PRICE PER SERVER	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	USABILITY	OVERALL
Visual InterDev	\$499 stand-alone; \$249 upgrade	None extra	★★★★★	★★★★	★★★★	★★★★★	★★★★★
Cactus 5.0	\$3400	\$5600	★★★★	★★	★★★★★	★★★	★★★★
Domino/Notes 4.6	\$495	\$1495 single CPU; \$3495 SMP	★★★★★	★★★★	★★★★	★★★★	★★★★
HAHTsite 3.0	\$1995	\$4995 and up/\$7495 and up (distributed app server) per CPU	★★★★★	★★★★	★★★★★	★★★★	★★★★
VisualWave 2.0	\$4995	\$4995 and up	★★★★	★★★★	★★★★	★★★	★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

path data, case sensitivity, and other dependencies. You can use the Visual Web Debugger locally or on a remote system via a password-protected TCP/IP connection.

Cactus

Information Builders' Cactus 5.0 takes cross-platform a big step further, offering client/server/Web applications that scale right up to mainframes. Cactus works with Information Builders' Enterprise Data Ac-

cess (EDA)/SQL middleware servers to allow three- and *n*-tier partitioning over a variety of protocols on 70 database types on 35 platforms. Cactus's Maintain 4GL programming language runs natively on Unix, NT, and MVS, doing in one line of code what would take 10 lines in VB or 20 lines in Java. The language-learning curve is offset by the Case Assist syntax wizard.

In the Cactus Workbench, you use the Form Painter to develop your application's

front end, navigating the Object Browser to access and control your presentation, business-logic, and data-access components. File Painter gives a hierarchical view of database structures, and Partitioning Manager lets you drop locally developed procedures onto multiple servers.

Converting a Cactus client/server application to the Web takes one click; the toolbox toggles to offer alternatives based on the current mode. Proprietary code maintains pixel-perfect positioning of form objects, and you can view HTML tags in the Properties dialog box. Java applets, tables, and image maps can be inserted and configured with ease; both JavaScript and VB-Script are supported.

When a browser requests a Cactus application, the Web server calls a CGI program that sets environmental variables and sends connection information to the Cactus Persistent Attach Manager. This process checks the IP address and cookie data, spawns a new task for a new connection, and maintains the state of existing ones. Though processor-intensive, CGI's widespread platform support makes sense in Cactus's universe.

VisualWave

VisualWave 2.0 inherits a large base of client/server applications from Object-Share's (formerly ParcPlace-Digitalk) VisualWorks, which uses Smalltalk and its library of more than 900 classes and 24,000 methods. VisualWorks divides applications into an information model, which handles data storage and processing, and a user interface, which handles I/O. This

TECH FOCUS PERSONALIZING PAGES

At Your Service

The mechanism for serving dynamic pages varies from vendor to vendor, but there is some common ground. When a browser makes a request to Microsoft's IIS for an ASP page, the server initializes application- and session-scoped variables, procedures, and methods. A globally unique identifier (GUID) is generated in both the session object on the server and the browser's memory, in effect acting as a memory-based cookie. The application then checks the global ID as each user moves through the application session.

HAHTsite projects can be published so that state IDs are either stored in cookies or included in URL strings. In the latter scenario, developers drag and drop links to a static start page; the IDE dynamically generates an elaborate URL when the site is published to Haht's Application Server(s). For example, the link to start a new session might look like this:

http://www.southerndigital.com/cgi-bin/hsrun/webapps/MyApp.htm;start=HS_LoginPage

The hsrun CGI program (or other API module) generates a state ID string, which is then embedded in other links on the generated page returned to the browser. Then hsrun decodes subsequent URL requests to identify which Application Server process gets the request.

Like IIS and its tightly linked ASP engine, the Domino server uses a variant of IBM's ICS 4.2+ HTTP server. When a page is requested, Domino examines the URL and, if it determines the data is a static page, sends it through for normal processing. If it recognizes the URL as a Notes object, then it passes the request to Domino, extracts the object from the Notes NSF database, does a dynamic conversion to HTML, and sends the page to the browser. Domino binds data from its own database to its programming logic late in the process, applying a form's formulas, scripts, and images to do a lot of processing before generating the page.

W E B T O O L K I T		F E A T U R E S					
	Visual InterDev	HAHTsite	Cactus	VisualWave	Domino/Notes	Fusion	Netiva
AUTHORING TOOLS							
WYSIWYG visual editor	✓	✓	✓			✓	✓
Color-coded HTML editor	✓			✓			N/A
Graphics editor	Bundled	✓		✓			
Debugger	Downloadable from Web	✓		✓	✓		✓
Design-time controls	✓	✓			Dynamic views, navigators		
Java applets	✓	Create and add	✓	✓	✓	✓	✓
ActiveX controls	✓	✓	Manual	✓	✓	✓	
Frames editor/wizard		Wizard		Editor	Wizard	Editor	Editor
Image-map editor/wizard	Editor	Editor	Editor	Editor	Editing within IDE	Editor	Editor
Client-side scripting editor/wizard	Both	Both	Editor		Editor	Bundled Acadia InFuse JavaScript/HTML editor	Macro editor
Multibrowser preview	✓	✓	Manual	Manual	✓	✓	
Pixel-perfect positioning			✓			✓	✓
Extensible IDE	✓	✓		✓	✓		
Templates	✓	✓		✓	✓	✓	✓
SITE MANAGEMENT							
Site view	✓	✓			Dynamic views	✓	
Project view	✓	✓	✓	✓	✓	✓	✓
Link repair	✓	✓	✓	✓	✓	✓	
One-button publishing	✓	✓	✓		Via replication	✓	✓
Session/state management	✓	✓	✓	✓	Post-authentication		✓
Site import	✓	✓	✓	✓		✓	
DATABASE TOOLS							
ODBC	✓	✓	✓	✓	✓	Static only	✓
Native drivers	ODBC	Oracle7, Sybase, Microsoft SQL Server, Informix	60 databases via EDA	Oracle7, Sybase, SQL Server 10 and 11, Informix	ODBC	ODBC static only	Microsoft SQL Server, Oracle7
Built-in database			✓		✓	Static only	✓
Data-bound HTML	✓	✓	✓	✓	✓		
SQL generator	✓	✓	✓	✓	✓		
APPLICATION SERVER							
Server-side scripting	VBScript, JScript	HAHTtalk Basic, Java	VBScript, VBA, JavaScript	Smalltalk	LotusScript Agents, Java Agents		Macro processing via persistent client connection
Platforms	Windows 95, NT	NT, AIX, HP-UX, Solaris	MVS, VM, Unix, NT, VMS	NT, HP-UX, Solaris	NT, Solaris, HP-UX, AIX, OS/2, OS/390, NetWare		Windows 95, NT
Protocols	TCP/IP, DCOM	TCP/IP, CORBA, IIOP, DCOM	TCP/IP, LU6.2, LU2, phone	TCP/IP, CORBA, IIOP	TCP/IP, Notes, RPC, NNTP, LDAP, POP3, SSML 3.0, IMAP		TCP/IP
Built-in Web server	Development version	Development version		Development version	✓	N/A	
Web server support	IIS, Personal Web Server for Windows 95	All	Any supporting CGI and HTML 2.0 and higher	All	Domino	All	All
Java run-time	✓	✓			✓	N/A	
CGI, ISAPI, NSAPI	ISAPI	✓	CGI	CGI, NSAPI	CGI	✓	N/A
Multitiered applications	✓	✓	✓	✓	✓		✓

★ = BYTE Best

✓ = yes

N/A = not applicable

allows the reuse of components in different types of applications and lets developers maintain relatively stable elements (e.g., inventory control and accounting) while updating more volatile user interfaces.

VisualWave's IDE adds Canvas, Layout, Hot Regions, and Frames editors to the parent VisualWorks toolkit, which contains browsers, inspectors, a symbolic debugger, and file and resource managers. The interface is difficult for the average Windows user, but it proves efficient once you've mastered it. The program dynam-

ically generates HTML and CGI interfaces.

VisualWave supports ActiveX controls, Java applets, JavaScript, and an Image-to-GIF converter that renders graphics drawn using the Image Editor and the bundled business-graphics library. You paint your canvas from a typical selection of widgets, although some types of controls—group boxes, combo boxes, and sliders—don't survive the voyage to HTML. VisualWorks provides a menu editor, but VisualWave converts the results into an image that acts like a set of buttons on the page.

VisualWave comes with a personal Web server to test your code. You need the separate VisualWave Server to deploy completed applications in conjunction with HTTP servers, including Netscape, IIS, NCSA, and WebSite.

Domino/Notes

The 4.6 release of Lotus's Domino/Notes offers unique tools for creating and maintaining internet/intranet sites. The Domino Web server renders an interactive combination of Notes databases, Java agents,

Two More for the Show

I also evaluated two innovative products that fell just outside the target scope of this report. NetObjects' Fusion 2.0 combines intuitive WYSIWYG PageDraw and SiteStructure editors with SiteStyles and Assets managers to enable RAD Web-site authoring. It lets you drag and drop Java, ActiveX, QuickTime, Shockwave, and Fusion NFX components with pixel-perfect control, but you need third-party products to allow database interaction. An AutoFrames wizard lets you place sitewide navigation controls and logos on the margins of your pages.

You can mix and match 50 visual theme templates in different sections, import existing sites and ODBC data, and stage and publish your sites with versions optimized for different browsers and bandwidth limitations. Fusion automatically creates and updates all navigation bars and links as you rearrange and rename your pages; the Assets view's Verify All Links command uses your default Internet connection to generate a report on all internal and external links.

Netiva uses a visual, page-based interface to create client/server

applications that are downloaded to a Java-enabled browser. Netiva Server connects to an Intelligent Java Client running in the browser, monitoring users and providing session/state management for up to 100 simultaneous applications. The built-in relational database sports a transactional design; you use the Macro Editor's 40 VB-like commands, syntax checking, highlighting, and debugging to wire together back-end data pages with front-end entry and report forms.

Netiva doesn't produce any HTML, but you can insert a Netiva URL into a traditional page as a tagged applet or in its own frame. The package includes templates for HR benefits and contact and project management; you can connect to Oracle, Microsoft, Sybase, Informix, and DB2 data sources in real time. You can't share data across applications, a Java limitation that will be eliminated by the forthcoming JavaBeans support. Combining Fusion with Netiva could provide capabilities rivaling those of next-generation solutions, such as Sybase's PowerSite (to be reviewed in the January 1998 BYTE).

and pass-through HTML, adding integrated SMTP MTA messaging, IMAP, POP3, NNTP, LDAP, and Secure Sockets Layer (SSL) 3.0 security services. A new browser-based administration panel smoothes the daunting Notes learning curve.

The Notes Designer client takes giant steps in managing the interoperability between Notes and Web versions of applications. Developers can now hide application elements from Web or Notes users programmatically and write Java agents to supplement canned actions, formulas, and the VB-like LotusScript. Notes Access Control Lists (ACL) let you authenticate and track users dynamically and offer customized data and work-flow capabilities.

New templates and sample applications

include threaded discussion, registration, a document library, mail, a frame-set generator, and a Web-page cataloger. The client features tight integration with Internet Explorer, using its ActiveX component to test pages inside a Notes document window with the Preview command. Active Document support lets you integrate Microsoft Office, Lotus SmartSuite, and VB-created applications into the IDE. You can use the bundled Lotus BeanMachine to author Java applets and then embed and execute them within Notes forms.

Domino's replication technology makes it easy to author sites on a workstation and then deploy them across firewalls to multiple Domino servers. Although the product does not provide a drag-and-drop view,

you can use a combination of embedded views, navigators, and folders to let users manage the site as they add, modify, and move documents through the Notes object store. LotusScript extensions provide ODBC access, and Java CGI support allows multithreaded Java servelets to stay resident in the Domino server's Java virtual machine (VM) for multiple concurrent requests.

Summing Up

Visual InterDev narrowly captures first place by combining price/performance with features that come close to those of HAHTsite's comprehensive tool set. But in many ways, each of these products is best of breed in its primary constituency.

Visual InterDev's natural advantage as an NT loss leader is offset by HAHTsite's cross-platform embrace of both DCOM and CORBA. Meanwhile, Cactus offers a highly scalable solution for migrating millions of lines of legacy client/server code, and VisualWave delivers on Smalltalk's goal of reusable business-based objects. Both Cactus and VisualWave work toward the same goal of rapid translation of existing client/server applications, but they take quite different routes.

Domino/Notes 4.6 is an obvious choice for Notes shops. But its integrated Web server, programmable architecture, single object store, NT integration, and balanced adoption of ActiveX and Java make this solution a good choice for others. ■

PRODUCT INFORMATION

Cactus 5.0
\$3400; \$5600 per NT server
Information Builders
New York, NY
800-969-4636
212-736-4433
fax: 212-967-6406
<http://www.ibi.com/>
Enter 1090 on Inquiry Card.

Domino/Notes 4.6
\$495; \$1495/\$3495 per
single/SMP server
Lotus Development Corp.
Cambridge, MA
617-577-8500
<http://www.lotus.com/>
Enter 1091 on Inquiry Card.

Fusion 2.0
\$295
NetObjects, Inc.
Redwood City, CA
415-482-3200

fax: 415-562-0288
<http://www.netobjects.com/>
Enter 1094 on Inquiry Card.

HAHTsite 3.0
IDE, \$1995; Integrated
Publisher, \$695 per developer;
Application Server, \$4995/
\$6995 per CPU (NT/Unix);
Distributed Application Server,
\$7495/\$9995 per CPU (NT/Unix)
HAHT Software, Inc.
Raleigh, NC
888-438-4248
919-786-5100
fax: 919-786-5250
<http://www.haht.com/>
Enter 1092 on Inquiry Card.

Netiva
\$1999/\$2999/\$4999
(for 2/4/10 connections)
Netiva Corp.
Campbell, CA

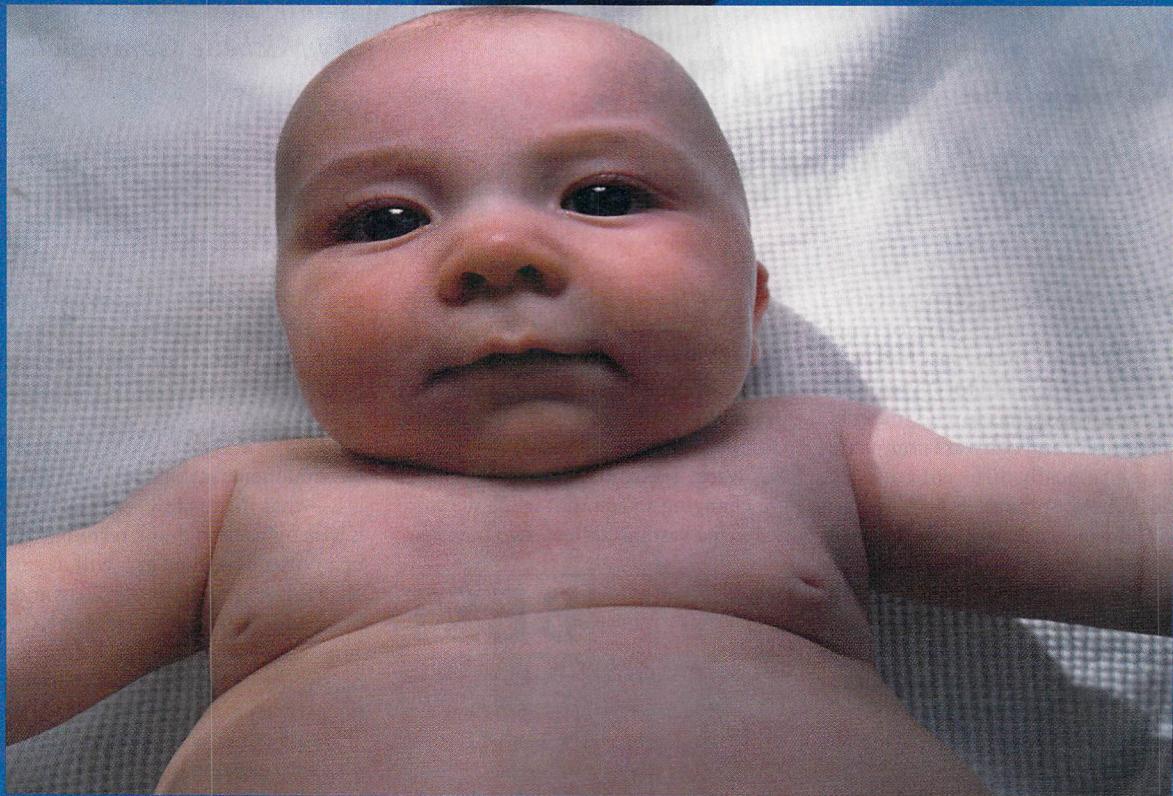
888-263-8482
408-379-2100
fax: 408-341-1830
<http://www.netiva.com/>
Enter 1093 on Inquiry Card.

Visual InterDev
\$499
Microsoft Corp.
Redmond, WA
425-882-8080
fax: 425-936-7329
<http://www.microsoft.com/>
Enter 1095 on Inquiry Card.

VisualWave 2.0
VisualWave Server 2.1, \$4995/
\$9995 (NT/Unix)
ObjectShare, Inc.
Sunnyvale, CA
408-481-9090
fax: 408-481-9095
<http://www.objectshare.com/>
Enter 1096 on Inquiry Card.

Steve Gillmor is a consultant with Southern Digital in Mount Pleasant, South Carolina. You can reach him at sgillmor@southerndigital.com.

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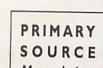


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TOSHIBA



Back to the Future with 9 Network Computers

The network computer (NC) has been the focus of much debate in the past few years as a demand for lowered administration costs has forced many PC manufacturers and software companies to chart a radically different course in product development. First they laid plans to develop new software and OSes that would shift complexities away from clients and toward professionally managed servers. Next came "thinner," less expensive hardware devices capable of easy access to such networked applications as e-mail and the Web.

Today, the dream of large-scale NC deployment has yet to be achieved. Confusion reigns as vendors continue to announce—but rarely ship—what they claim are new and better versions of NCs, thin clients, terminals, NetPCs, and similarly named systems. Joining these systems in this sea of confusion are handheld PCs, TV set-top boxes (e.g., WebTV), and even managed PCs, all taking on many of the concepts of thin clients.

In addition, NCs have proved to be more difficult to design, produce, and implement than many of their proponents first thought. Oracle-compatible NCs are just now reaching the market, and Sun Microsystems has only recently started shipping its JavaStations in volume. Reality has also stepped in with regard to the heavy reliance on Java, as Corel's abandonment of its Java office program demonstrates.

Still, these thin clients are becoming a reality. And they can provide some real benefits, albeit with more caveats than originally thought.

Thin-Client Alphabet Soup

To help you sort through the NC confusion, we rounded up and tested nine prototype units from AST, Boundless, Compaq, Hewlett-Packard, NCD, NEC, Neoware, Tektronix, and Wyse. Things are changing so fast that while we were acquiring systems to test, two manufac-

Stretching the envelope or a blast from the past? BYTE reveals what's new about these nine NCs.

By Michelle Campanale

and Sun said their Java boxes will ship soon after this article sees print. This demonstrates just how difficult these vendors have found it to deliver practical NCs.

Defining the Field

NC opponents say the NC is virtually useless—that it runs few applications and is a throwback to dumb terminals. Connectivity costs, they say, will negate an NC's lower administration costs and low price tag. They also worry that NCs will generate huge amounts of network traffic, swamping all but the fastest asynchronous transfer mode (ATM) networks.

Despite these criticisms, many companies with existing high-speed networks, already-low administrative costs, and employees who require single-task computers have deployed NCs and are reaping the benefits of lower administration costs. They are likely deploying one of two types of devices currently on the market, which are based on either the NetPC specification or the NC1 Reference Profile. We asked vendors to send us NCs based on these two most widely used specifications.

The NetPC spec is a reference-profile specification for a low-maintenance PC system built with the network in mind. The initiative was developed by Intel, Microsoft, and other PC manufacturers, including Compaq, Dell, Digital, Gateway, and HP (see the chart on page 126).

The NC1 Reference Profile, which was originally defined by Apple, IBM, Netscape, Oracle, and Sun, is the minimum set of hardware requirements and network protocols that must be supported for any device to be branded an NC. In

BYTE BEST NETWORK COMPUTERS

Neoware @work Supra-66

The top-performing Neoware @work Supra-66 represents the best of the NC1 systems. This ICA-compliant unit comes with a Java-enabled browser and Java interpreter, and it supports the X Window System.

Hewlett-Packard HP Net Vectra

The HP Net Vectra offers outstanding graphics support in addition to its full features set. Also, HP bundles a variety of handy management utilities and offers a keyboard with an attached smartcard reader.

turers indefinitely postponed their NetPCs. Citing tepid customer response, IBM and Digital Equipment both suspended their NetPC rollouts. And at press time, some of the original NC proponents (Apple, IBM, Oracle, and Sun) had not yet shipped even their first-generation Java-based NCs to customers in the U.S. (beyond their existing beta tests). Their second-generation Java products were not ready in time for our tests, although IBM

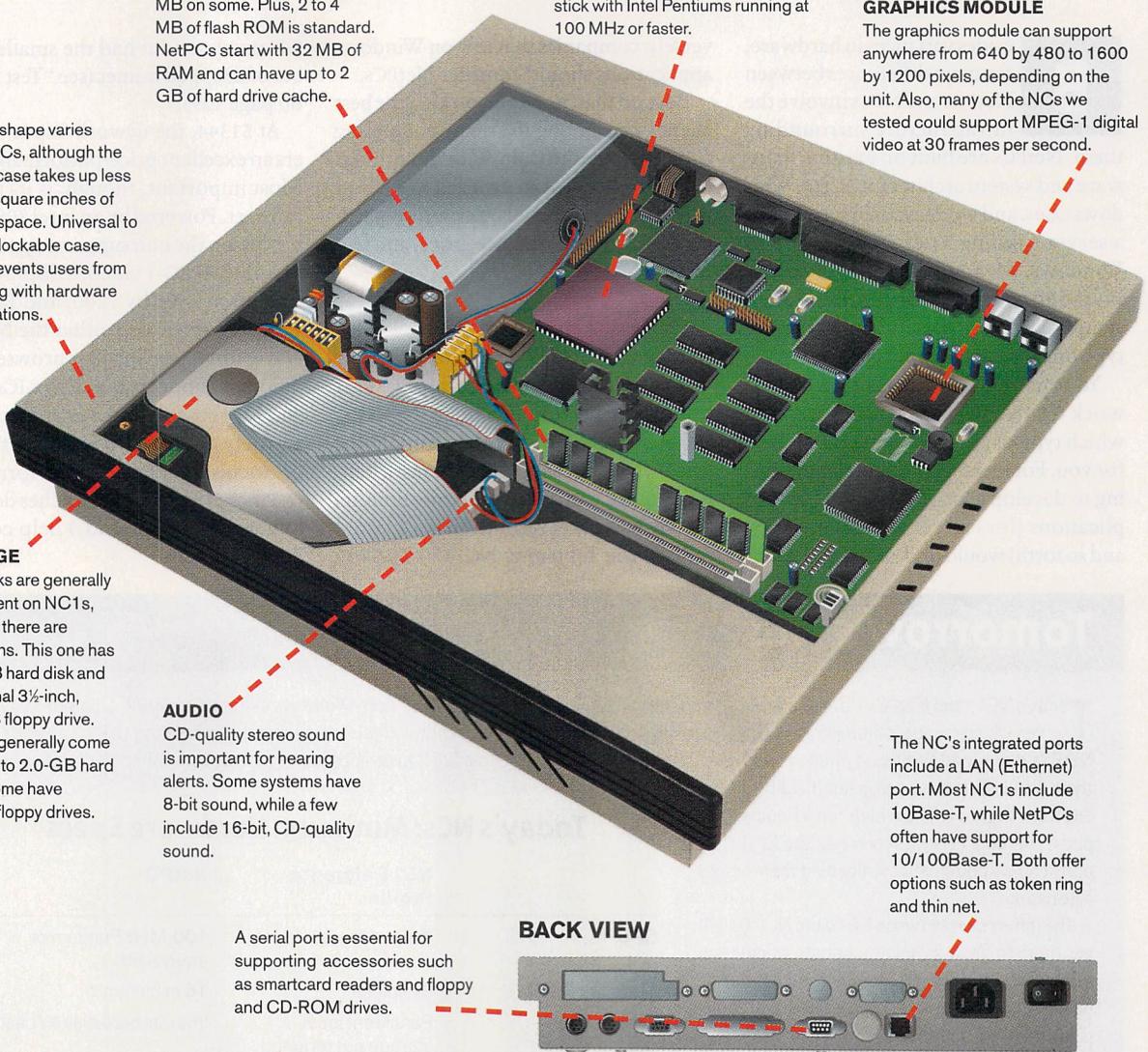


Illustration is based on the Neoware @work Supra-66.

practice, the NC1 category also includes Java terminals and thin Windows clients based on Citrix's WinFrame technology, soon to be known as Hydra.

For the most part, NC1s are super-fancy X Window System terminals, while NetPCs are just stripped-down PCs. (Eventually, regular PCs will have all the features of NetPCs.) Specifically, what makes NC1s different from NetPCs is their new server technologies, which support Java, multi-user functions, and more management. For example, new Windows NT user-profile and policy-management features make NetPCs much more manageable than ever.

In many respects, NC1s and NetPCs fill the same niche and can handle many of the

same tasks. For example, Windows applications can be accessed on an NC1 using Winframe derivatives. But the real technology innovations with thin clients have as much to do with what's going on in the server as they have to do with what's happening on the client.

For our tests, however, we chose to focus on the client. We asked vendors to send us NetPCs with 100-MHz or faster Pentium processors, 16 MB of RAM, an internal hard disk (for caching support), 10Base-T Ethernet support, and an SVGA-compatible display adapter supporting resolutions of at least 1024 by 768 pixels. We also asked that each client be capable of booting and attaching to an NT server

and that it include any boot-up, networking, and router software that might be necessary for it to run under NT.

NC1s needed a VGA-compatible display adapter with 1024 by 768 resolution, 16 MB of RAM, and 10Base-T Ethernet. They also had to have a Web browser with Java capability and connectivity software for either NT or Sun Ultra (Solaris).

Contributors

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Besides variances in hardware, the main differences between NetPCs and NC1s involve the infrastructure surrounding them. NetPCs are built on existing hardware and system architectures, run Windows OSes, and work in conjunction with a server running a network version of Windows. Meanwhile, the NC1 spec is intended to be an independent, open standard. Thus, it specifies no particular type of processor, client OS, or server.

Your network infrastructure or network OS (NOS) references determine which type of NC (NC1 or NetPC) is best for you. For instance, companies intending to develop a lot of their own Java applications (for call centers, sales clerks, and so forth) would find NC1s ideal. Con-

versely, companies that rely on Windows applications should consider NetPCs.

Beyond that, however, picking the best client from among the many competing choices can be difficult. With these things in mind, we chose to award a BYTE Best in each category based on criteria regarding graphics performance, price, and features set.

The Best NC1

Among all the NC1s we tested, the leader was the Neoware @work Supra-66. It was the top performer among the NC1s, although it bested its closest competitor (the Wyse Winternet 2310SE) by just a hair. It was quick with video-response time, its 800-by 600-pixel resolution was bested only by the Tektronix NC217's 1024 by

768 pixels, and it had the smallest number of dropped frames (see "Test Results" on page 129).

At \$1344, the @work Supra-66 delivers an excellent price/performance ratio. Most important, though, is its rich features set. Powered by an Intel 80960 RISC processor, the unit supports up to 132 MB of RAM, MPEG-1 video, a display resolution up to 1600 by 1200, and Java software. It comes with either the Netscape Navigator 3.0 or Spyglass browser. In addition, it supports the Citrix ICA, Unix, and X protocols and comes loaded with a variety of network, Internet, and boot protocols. Finally, its small form factor (2.3 inches high by 12.75 inches deep) and low weight (7½ pounds) help conserve desk space.

Tomorrow's NCs

Today's NC1s and NetPCs store applications and files on a central server, which reduces administrative costs. However, unlike NC1s, NetPCs download Windows applications over a network and run them locally. This approach is significantly different from that of NC1s, which run Windows applications on a central server (via the Citrix ICA protocol) without first downloading them across a network.

The differences between NC1s and NetPCs will continue to grow as new technologies emerge. Microsoft's Windows NT 5.0 OS, which is due to be released sometime in 1998, will support policies and roles tied to a directory and roaming-application support for NetPCs. Through NT 5.0's policy-based management, you will be able to assign an application—say, Excel—to a profile or a policy. Even if a particular machine doesn't have Excel, the server can still "push" the application and load it. Upcoming Windows Terminals are expected to run on the Windows CE 2.0 OS, support a variety of hardware shapes and sizes, and run on multiuser windows, such as Hydra (an add-on to NT 5.0 that is expected to begin shipping late this year). Designed as a Windows-to-Windows terminal solution, these next-generation systems will provide some of the functionality of low-end applications using a protocol called T-Share. They will also integrate with NT5 Admin (also known as Microsoft Management Console, or MMC).

Meanwhile, Citrix will continue to sell its multiuser software for NC1 vendors. Currently called Picasso, the newest Citrix product will add the ICA protocol stack to NT 4.0 as well as some additional administration features. Most important, it will continue to con-

nnect ICA and non-Windows clients. Citrix will also sell a Java ICA client that will allow any computer running the Java virtual machine (VM) to remotely interact with any Windows application.

Today's NCs: Minimum Hardware Specs

	NC1 Reference Profile	NetPC
CPU	Various types	100-MHz Pentium or equivalent
Memory (MB)	8 minimum	16 minimum
Disk	Persistent local storage not required	Internal hard disk as cache
Video (pixels)	640 by 480 minimum	640 by 480 at 8 bits per pixel (VGA) (Type unspecified)
Audio device	Audio output required	
Plug-and-play BIOS support	Not required	Required
Expansion slots	Not required	Not required
Network interface	Required	Required
Keyboard, pointing device, mouse	Required	Required
Locked, sealed case	Not required	Required
Optional hardware additions	Not specified	IDE floppy drive, CD-ROM, PC Card slots, USB, 1394 high-speed peripheral bus

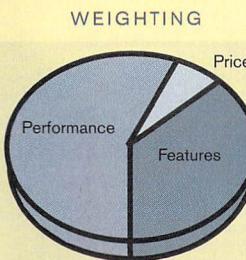
Another upcoming package, from GraphOn, will migrate NT users to Unix and let Windows Terminal users access Unix applications as well as Windows, Mac, and NC applications—all while having interoperability with, and connections to, legacy apps. The as-yet-unnamed product will be shipped when Microsoft delivers NT 5.0.

LAB RATING RESULTS

BEST NC1

Neoware @work Supra-66

The best system for heterogeneous environments, the Neoware (formerly HDS) @work Supra-66 runs ICA-compliant server and client software, includes a Java-enabled browser and Java interpreter, and supports both legacy and X Window System protocols. Additionally, it bested all the other NCs in our graphics tests.

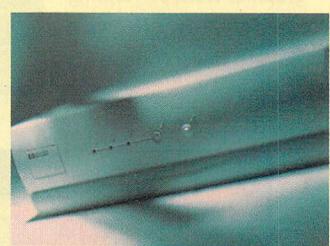
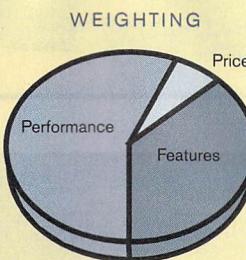


	PRICE	TECHNOLOGY	PRICE	PERFORMANCE	FEATURES	OVERALL RATING
Neoware @work Supra-66	\$1344	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
Boundless Technologies Viewpoint	\$799	★★★★★	★★★★★	★★★★★	★★★	★★★★★
NCD Explora 700	\$1695	★★★★★	★★★	★★★★★	★★★	★★★★★
Wyse Technology Winternet 2310SE	\$899	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
Tektronix NC217	\$1895	★★★★★	★★★	★★★	★★★	★★★

BEST NETPC

Hewlett-Packard's HP Net Vectra

With its outstanding graphics support, the superior-performing HP NetVectra bested all other NetPCs in our tests. But speed and performance are not all that set it apart from the rest. It comes with a lockable chassis and a variety of preloaded management tools, and it has an optional smartcard-ready keyboard and security software.



	PRICE	TECHNOLOGY	PRICE	PERFORMANCE	FEATURES	OVERALL RATING
Hewlett-Packard HP Net Vectra	\$1500	★★★★★	★★★	★★★★★	★★★★★	★★★★★
Compaq Deskpro 4000N	\$1249	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
NEC PowerMate	\$1649	★★★★★	★★	★★★	★★★★★	★★★★★
AST Computer Bravo NP 5166	\$1199	★★★★★	★★★★★	★★★	★★★	★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

The Best NetPC

In a close match, HP's \$1500 Net Vectra wins the top award among the NetPCs we tested. It fared exceptionally well in our graphics tests, edging out both the Compaq Deskpro 4000N and the NEC PowerMate Enterprise NetPC by a few points. The Net Vectra's 64-bit Trio 64 V2 graphics controller greatly aided the system, which runs on Windows NT 4.0 Workstation. The accelerator is integrated onto the motherboard along with 2 MB of EDO DRAM, which is used for video memory. The system can support resolutions up to 1600 by 1200 pixels.

But graphics performance isn't all that sets the HP Net Vectra apart. The system comes with a unique cooling system. Rather than using a fan or a heat sync for the processor, HP installs a heat pipe on the system. The rod-shaped device, which is

attached to the processor, is filled with water. The pipe leads out to the chassis's exterior and conducts heat away from the processor.

HP also includes a good selection of management utilities, such as the HP Top Tools DMI 2.0-based management-software package. The Net Vectra also comes with an Advanced Configuration and Power Interface (ACPI) controller for power management.

Finally, the Net Vectra unit comes with additional notable security features, including a lockable screen saver and chassis, plus security software for the optional keyboard smartcard reader.

Feature Champs

In addition to the inclusion of management software, other NC trends surfaced during our tests. Important to thin clients are such things as audio support, MPEG

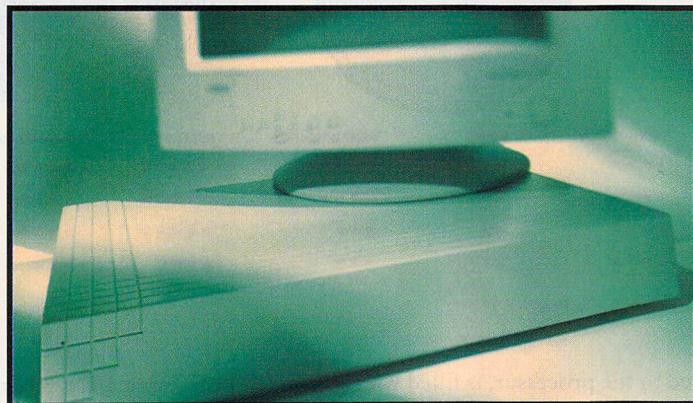
support, just-in-time (JIT) recompilation, and smartcard compatibility. With regard to these criteria, top honors go to Compaq's Deskpro 4000N and Network Computing Devices' Explora 700, which both performed well and included many of these cutting-edge features.

The Compaq Deskpro 4000N sells for just \$1249, yet it performed extremely well in our tests and has loads of features, including MPEG-1, smartcard support, and JIT recompilation. It was one of only two NCs we tested that ran on a 200-MHz Pentium processor.

The second features champ, NCD's \$1695 Explora 700, includes PC Card support, 8-bit audio, and an optional smartcard reader. Expandable to 256 MB of RAM and powered by a 150-MHz Mips R4700 processor, the NCD Explora 700 painlessly ran Java applets in its Spyglass browser.

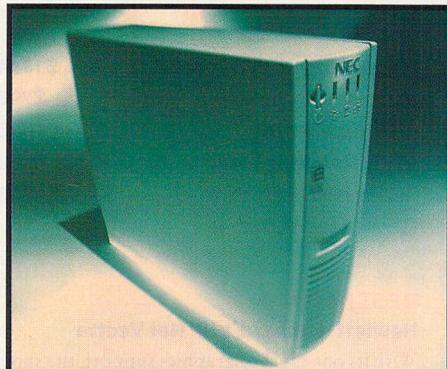
The Myth of Footprints

Form factor is a key NC selling point, and one of the smallest, most innovative designs belongs to the Wyse Wintern. Weighing 12½ pounds, the Wintern measures 8.9 inches tall and 6.9 inches deep. But although it's small on size, it doesn't compromise on performance. The Wintern raged under the strain of our graphics tests, performing second only to the Neoware @work Supra-66.



Sounds Good

NEC's PowerMate ships with 16-bit sound, good for hearing alerts in many Web and business applications. Many of its competitors don't come with audio, or they use 8-bit sound.



Chameleon in NC Clothing

Besides its ability to run Windows and Unix applications, NCD's top-of-the-line NC, the Explora 700, is optimized for Java. It's powered by a 150-MHz Mips R4700 integrated FPU with a 64-bit bus. Currently, it comes standard with the Spyglass browser, although NCD has plans to incorporate different browsers in the future.

TECH FOCUS

Double-Edged Sword?

The current crop of NC1s rely on older networking protocols, such as the X Window System and remote sessions to Windows NT, for most of their functionality. Most of the NC1s we tested had Java compilers, where everything runs through a totally interpreted Java virtual machine (VM). Yet the vendors of these NC1s tout as their systems' biggest benefit today the ability to run ICA protocols and multiuser Windows applications. Some NC1 vendors even say that Java would be best served running on a full-fledged PC.

Arguably, Java is far from perfect. But do its disadvantages outweigh its pluses? One of the primary responsibilities of the Java VM is to interpret incoming code into the native machine language. This allows the same Java applet to be shared by different hardware without being recompiled for each platform.

This approach presents the usual performance problems. For exam-

JAVA

ple, the first time you import an object into the Java VM, it gets interpreted. As a result, it's slow. However, future calls made to that object are much faster, since it's then in memory.

In addition, the Java VM was designed without a permanent file system. For temporary storage it uses cache, which gets cleared out when it's not regularly used. Applications in the Java VM are restricted from making I/O calls. On the upside, this might provide some security advantages because it allows you to run applications in a protected environment. It's also useful if you download virus-prone programs from the Internet. The disadvantage is that it requires you to reload all applications into the Java VM each time you boot up. Although Java cross-platform compatibility now comes at the expense of performance, just-in-time (JIT) compilers and Java chips are expected to make serious inroads within the next year and could narrow the gap.

Buying an NC, either an NC1 or a NetPC, makes sense if you have the existing infrastructure. Initial resources are important because 99 percent of the administration occurs during setup. In addition to high-speed networks and powerful servers, having enough personnel to administer your LAN is key.

Some of the reasons for buying an NC relate to platform. Companies that have the resources to develop their own Java applications, such as those with call centers and sales departments, will benefit from an NC1. Meanwhile, companies that rely on Windows applications will fare better with a NetPC.

Cost of ownership might be another motivation for buying an NC. But the hardware dollar savings associated with NCs might not be as high as people think. Costs simply shift toward servers. The centralized, server-dependent, thin-client model creates the need for additional server memory, backup, and administration. Still, value and price-per-seat considerations of NCs are not a moot point. When every dollar counts, these factors still impact purchasing decisions.

To help you decide, for this review we did an analysis of NetPCs and NC1s in three areas: performance, price, and features. We weighted performance at 60 percent, features at 30 percent, and price at 10 percent. Because all the units tested were early prototypes, no documentation was available. Therefore, usability, which focuses mainly on how easily a unit sets up in accordance with its written documentation, was not included as part of the scoring.

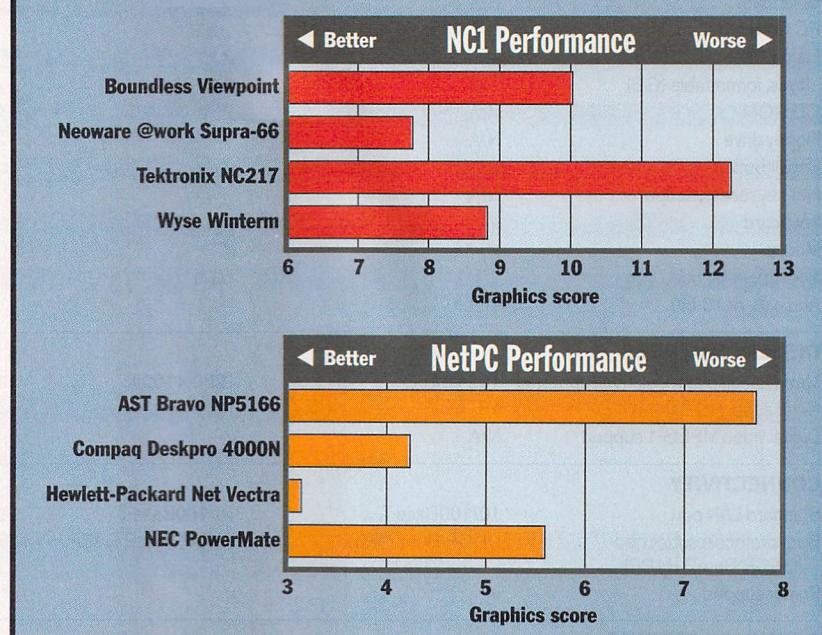
Performance

If your infrastructure can accommodate an NC, you'll want to look at how well

the unit performs. For our performance tests, we connected the NC1s, which run proprietary OSes, to a PC server running Citrix-compatible Windows NT 3.51. We connected the NetPCs, which ran NT 4.0 Workstation, to a PC server running NT 4.0 Server. However, since we were primarily testing the clients, we deemphasized their network functions and net-

ing CorelDraw, Excel, Freelance Graphics, Powerpoint, and Word. All tests are performed by drawing into memory, as well as drawing directly to the screen. The current procedure tests bit-mapped images in 160 by 120 and 320 by 240 pixels. InterMark also tests native-format, monochrome (4-, 8-, and 32-bit), and device-independent bit-mapped images.

Graphics Test Results



These NCs' ability to deliver the graphics goods varied from excellent to awful.

work performance in the final ratings.

In addition, because NC1s and NetPCs have fundamentally different architectures, we didn't test them in head-to-head competition. We assumed that real-world NC1s would be deployed in a corporate intranet and attached to a set of applications and data servers. When doing the NetPC tests, we assumed that a corporation would deploy them as a direct, low-administration replacement for standard desktop PCs.

We ran the standard NSTL InterMark graphics-intensive benchmark on both flavors of NCs. InterMark includes a video test of primitive GDI operations, as well as the display of entire pictures generated by common applications, includ-

Other primitive operations tested include PatBLT, line draw, polygons, and ellipses.

Features

For the features score, we added up all extras that went beyond the initial specifications. We included such things as whether or not the Mac address could be both permanent and changeable.

In addition, systems with a smartcard interface or support, PC Card support, and MPEG-1 support were given top honors. Power buttons with multiple functions, hot-key reset buttons, and mouse and keyboard ports were also important features. Finally, we looked to see if the systems included audio, printer support, and a system warranty.

The evaluations in this report represent the judgment of BYTE editors, based on tests conducted by NSTL, Inc., as documented in a recent issue of NSTL's monthly PC Digest. To purchase a copy of the full report, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; 610-941-9600; fax 610-941-9950; on the Internet, editors@nsl.com. For a subscription, call 800-257-9402. BYTE magazine and NSTL are both operating units of The McGraw-Hill Companies, Inc.

NET PCS AND NC1S FEATURES

	NetPCs			
	AST Computer	Compaq Computer Corp.	Hewlett-Packard	NEC
Price as tested (MSRP)	Bravo NP 5166	Deskpro 4000N 5200X/1600	HP Net Vectra	PowerMate Enterprise NetPC
Overall rating	★★★	★★★★	★★★★★	★★★★
HARDWARE FEATURES				
CPU architecture/MHz	Intel MMX Pentium/166	P55c/200	MMX Pentium/166	MMX Pentium/200
Main memory (RAM) in MB	32 (SDRAM)	32 (expandable to 256)	32 (expandable to 192)	32 (expandable to 128)
Flash memory	INP	256 KB	256 KB	2 MB
Permanent ID	INP	✓	✓	✓
Changeable ID	N/A		Optional	✓
Smartcard	N/A		Optional	Optional
PC Card	N/A			✓
Hard disk	✓	✓	✓	✓
If yes, formattable (GB)	2.0	1.6	1.6	3.2
CD-ROM	N/A			
Floppy drive	N/A			
Power button	✓	✓	✓	✓
Hot-key reset function	N/A		✓	
Keyboard	✓	✓	✓	✓
Mouse	✓	✓	✓	✓
Serial/parallel/video port	2/1/1	1/1/1	1/1/1	2/1/1
Audio (8- or 16-bit)	16-bit			16-bit
DISPLAY FEATURES				
Maximum display resolution supported	1024×768	1280×1024	1600×1200	1024×768
Color support (bits)	16	16	24	16
Digital video MPEG-1 support	N/A	✓		
CONNECTIVITY				
Standard LAN port	10/100Base-T	10/100Base-T	10/100Base-T	10/100Base-T
Boot protocols supported (DHCP, BootP, RARP)	DHCP, BootP, PXE	DHCP, BootP, RARP	DHCP, BootP, TFTP	DHCP, BootP
Printer support	✓	✓	✓	✓
SOFTWARE OPTIONS				
OS/system support	Windows 95, NT 4.0	NT 4.0 (optional Windows 95 and OS)	NT 4.0	NT 4.0 (optional Windows 95)
Web browsers supported	Internet Explorer 3.02, Netscape Communicator	Internet Explorer 3.02	Internet Explorer 3.0	Internet Explorer 4.0, Netscape 4.0
Internet protocols supported	TCP/IP, NFS, SNMP	TCP/IP	TCP/IP	TCP/IP
PHYSICAL CHARACTERISTICS				
Weight (pounds)	10	20	16	13.5
Height (inches)	3.5	3.56	4.13	9.5
Depth (inches)	12	14.6	15.2	3.5
FCC rating	INP	B	B	B
CUSTOMER SUPPORT				
Warranty length (years)/coverage	1/P, L, R	1/P, L; on-site: 3/P, R	3/P, L, R	1/P, L, R; 3/P, L
Extended warranty/pricing	Yes/not defined yet	Yes/see Web site	Yes/annual	Yes/\$99 (3 years on-site)
Phone	714-727-4141	281-370-0670	415-857-1501	415-528-6000
Toll-free phone	800-826-4278	800-345-1518	800-322-4772	888-863-2669
On-line address	http://www.ast.com	http://www.compaq.com	http://www.hp.com	http://www.nec-computers.com
Inquiry number	1078	1079	1080	1081



= BYTE Best.

✓ = yes; N/A = not applicable;

INP = information not provided by company.

Warranty: P = parts; L = labor;

F = freight to repair center; R = return to customer.

NC1s

Boundless Technologies	Neoware Systems, Inc. 	Network Computing Devices, Inc.	Tektronix, Inc.	Wyse Technology
Viewpoint TC 200	@work Supra-66	Explora 700	NC217	Winterm 2310SE
\$799	\$1344	\$1695	\$1895	\$899
★★★★	★★★★★	★★★★	★★★	★★★★
5x86/133	Intel 80960 RISC/66	Mips R4700/150	NEC R4300/100	486/66
4 (expandable to 64)	16 (available from 8 to 132)	8 (expandable to 256)	8 (expandable to 72)	2
2 (expandable to 4)	2 and 4 MB (internal)	4 MB	Optional (2, 4, or 12 MB)	2 MB
✓	✓	✓	✓	✓
✓			✓	✓
✓		Optional		
✓	✓	✓		✓
	✓			
	1.0			
Optional	Optional	Optional	Optional	
✓	✓	✓	✓	✓
✓	✓		✓	
✓	✓	✓	Optional (\$50)	✓
✓	✓	✓	✓	✓
2/1/1	1/1/1	1/1/1	2/optional/1	2/1/1
	16-bit	8-bit	Optional	
1280×1024	1600×1200	1600×1200	1152×900	1024×768
8	8	16	8	8
	✓	✓	Optional	
10Base-T	10Base-T	10/100Base-T, 10Base-2	10Base-T	10Base-T
DHCP, BootP, DNS	DHCP, BootP, RARP	DHCP, BootP, RARP, TFTP, NFS	DHCP, BootP, MOP, NFS, TFTP	DHCP
✓	✓	✓	✓	✓
ICA	Net OS (ICA, Unix)	NCDware (Java, Unix, ICA)	WinD, Winframe (ICA), Unix	Citrix Winframe (ICA)
	Netscape Navigator 3.0, net OS Explorer (Spyglass), Java 1.0.2	Spyglass	Navio, Java 1.0	
TCP/IP	TCP/IP, NFS, SNMP, UDP, TFTP, CIFS, RTP	TCP/IP, SNMP, DNS/BIND, IEN116, XDMCP, LPD, NAS	TCP/IP, DECnet	TCP/IP
12	7.5	6.25	4	12.5
2.3	2.3	2.1	2.175	8.9
12.1	12.75	13.2	12.2	6.9
B	A	B	A	A
3/P, L, R	1/P, L, R	3/P, L, F, R	1/P, L, F, R	1/P, L, R
Yes/per-customer basis	Yes/\$49 for additional year	Yes/various packages	Yes/3/P: \$199	Yes/2 (free w/signature)
516-342-7400	610-277-8300	650-694-0650	See Web site	408-473-1200
800-231-5445	800-636-9273	888-446-3896	800-547-8949	800-438-9973
http://www.boundless.com	http://www.neoware.com	http://www.ncd.com	http://www.tek.com	http://www.wyse.com
1082	1083	1084	1085	1086

★★★★★ Outstanding

★★★★ Very Good

★★★ Good

★ Poor

OpenLink's Driver Suite and ISG's Navigator are middleware tools that give you heterogeneous database access. By Barry Nance

Drive Your Data Through the Middle(ware)

Quick: What's the best way to concurrently connect a variety of clients to Oracle, Sybase, SQL Server, and DB2 databases running on different servers, without loading multiple drivers? Hint: The answer isn't ODBC.

Rather, the appropriate tool is a generic data access driver or tool. A subset of middleware designed to overcome ODBC's limitations in multiple-database environments, data access tools distribute queries to different databases and provide additional APIs besides just ODBC. Two such tools are OpenLink's Data Access Driver Suite 3.0 and ISG's Navigator 1.1.

Each package is available for a variety of operating systems and database management systems, as detailed in the table at right. Note that both products can now connect to mainframe DB2, but only through gateways such as IBM's DDCS. OpenLink is developing an MVS-based server agent to eliminate the gateway, while ISG is just beginning its MVS efforts. In addition, ISG plans Navigator support for VSAM, Adabas, Mumps, and IMS/DB.

TECH FOCUS

JDBC Access Types

The Java folks have defined four methods for achieving Java Database Connectivity. Type 1, always meant to be temporary, uses a bridge driver to access existing ODBC drivers. Using several DBMSes involves loading the ODBC driver for each. Type 4 is native Java that translates the JDBC call to the DBMS API and will thus be different for each DBMS. Most programmers will want Types 2 and 3, which call a middleware layer. Type 2 is part Java, part native API. Type 3 is pure Java. For more information: <http://java.sun.com/products/jdbc/jdbc.drivers.html>.

ISG Navigator vs. OpenLink Driver Suite		ISG International Software Group's Navigator 1.1	OpenLink Software's Data Access Driver Suite 3.0
Price	\$5000 per 10-user license	\$1300 per 10-user license	 B
Technology Rating	★★★	★★★★	★★★★
Implementation Rating	★★★★★	★★★★★	★★★★★
Performance Rating	★★★★	★★★★	★★★★
OSes SUPPORTED			
Windows 95, NT, Solaris, HP-UX, AIX	✓		✓
SunOS, Irix, DG-UX, Sinix		✓	✓
DEC Unix	✓		
OS/2		✓	✓
OS/400	planned		
OpenVMS	✓		
MVS	planned		planned
DBMSes SUPPORTED			
Oracle, Informix, SQL Server, Sybase, CA-Ingres, DB2	✓		✓
Progress, Unify 2000, Postgres SQL		✓	
Rdb, RMS, C-ISAM	✓		
CUSTOMER SUPPORT			
Phone	781-221-1450	781-273-0900	
Toll-free phone		800-495-6322	
On-line address	http://www.isgsoft.com/		http://www.openlinksw.com
Inquiry Number	1068	1069	

 = BYTE Best

✓ = yes

★★★★ Outstanding

★★★★ Very Good

★★★ Good

★★ Fair

★ Poor

OpenLink supports the IPX/SPX, DECnet, and TCP/IP transport protocols, while ISG concentrates on TCP/IP.

I tested both sets of tools on a TCP/IP-based Ethernet LAN consisting of multiple NT Servers running Oracle7.3, SQL Server 6.5, and DB2 Universal Database 5.0, plus various clients (OS/2, Win 95, and Mac System 7). Evaluation criteria included the variety of available APIs, speed, robustness, and security.

I found OpenLink's suite the better tool for most applications. Its drivers are faster and run on more diverse platforms and connect to more databases. For instance, OpenLink's Java Database Connectivity (JDBC) drivers are small (the class file is about 45 KB) and quite speedy. But the key difference between the two products is the APIs each offers. While OpenLink pro-

vides JDBC (Types 1, 2, and 3), ODBC, and X/Open SQL CLI programming interfaces, ISG supplies OLE DB and ODBC interfaces. ISG says it'll have a JDBC Type 2 driver sometime in 1998, as well as an XA interface, and OpenLink says an OLE DB interface to its product will be ready in the same time frame.

Such promises aside, choosing between the two tools is easy. If I were developing an application using Microsoft tools and technologies, I'd use ISG Navigator. For non-Microsoft-centric development efforts, especially those based on Java, I'd pick OpenLink's Driver Suite. 

Barry Nance (barryn@bix.com), a computer analyst and consultant for 25 years, is the author of Introduction to Networking, 4th Edition (Que, 1997).

Powerful packages ported to NT allow professional 3-D animation on relatively inexpensive workstations. By David Em and Alex Pournelle

3-D Animation Blossoms on NT

Two years ago, creating high-quality 3-D animation took \$50,000 in Silicon Graphics hardware plus that much more in software. Now, nearly every major 3-D program has been ported to Windows NT and reduced in price, and you can get powerful Pentium and Alpha workstations for \$5000 to \$10,000.

High-end animation programs such as Microsoft's Softimage, which carried a \$60,000 price tag less than 10 years ago, are now available in the NT environment for a fraction of that. Once-exotic features (e.g., volumetric lighting, for beams of light; inverse kinematics, for lifelike character animation; and particle generators, for dust and smoke) are now standard, along with OpenGL drivers, for real-time viewing of smoothly rendered, lit, and textured surfaces.

Still, 3-D animation programs are complex application suites for modeling, texturing, animating, and rendering, each a deep discipline unto itself. Add new animation plug-ins such as third-party render shaders and dynamic-behavior tools, and usability can wind up like the Tower of Babel. In fact, every 3-D application takes a different approach to unifying its elements, with the result that no program's interface resembles another's.

To see where 3-D is at, we reviewed Newtek's LightWave, Kinetix's 3D Studio Max, and Softimage.

LightWave 5.5

LightWave began life on the Amiga, but it now comes for Alpha, Intel, Mac, Silicon Graphics, and Sun platforms. LightWave is popular in TV production, used in shows such as *Babylon 5*, *Star Trek: Deep Space Nine*, and *Hercules*.

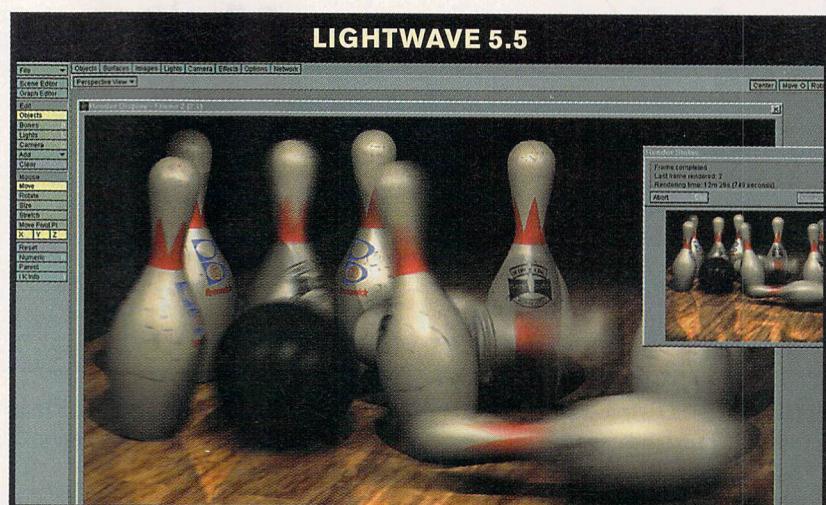
The program's impressive feature set includes modeling, animation, and efficient ray-traced rendering. You can network render on up to 999 machines with-



out expensive multiple CPU licenses.

Version 5.5 replaces the original clunky Amiga-like interface with a clean, new look. You can easily access all the elements of the program, and the menu layout is

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★
PERFORMANCE	★ ★ ★



legible and good. Subtle color coding of screen elements is a big help.

Unlike the other programs, with LightWave, you must switch between the two components, Modeler and Layout. In

RATINGS	
TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★ ★
PERFORMANCE	★ ★ ★

Modeler, you create, manipulate, and combine objects. Some tools, such as Meta-NURBS (nonuniform rational B-splines), aren't as powerful as those found elsewhere, but its overall capabilities are good. When you complete a model, you put it into Layout for scene composition, texturing, lighting, animation, special effects, and rendering.

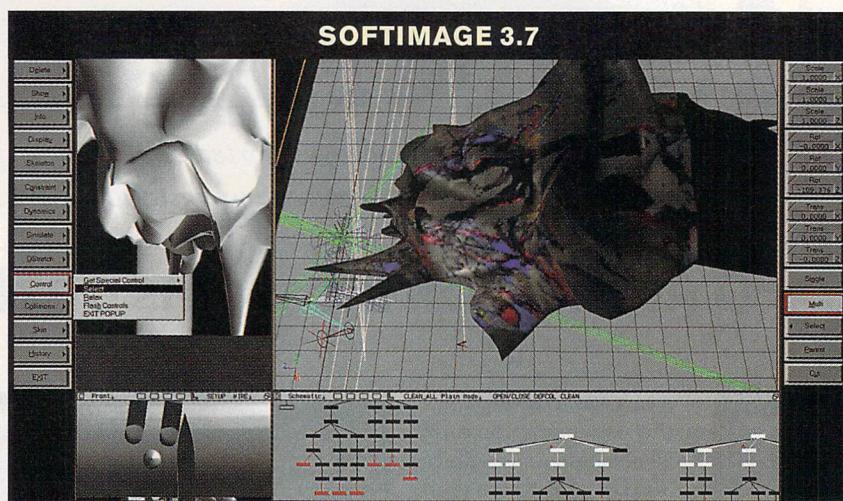
Modeler windows all zoom together, and you can't resize the many floating panels. Layout has Top, Bottom, Side, Perspective, and Camera views, but you can use only one at a time. You can't move a camera in Top view and see the result in Camera view.

Ray-tracing antialiased images is typically time- and processor-intensive, but LightWave has one of the best-performing ray-trace renderers on the market. Plug-ins make it possible to render 3-D scenes to look like cartoon cel animations and to show lens flares, fog, and particle blur at resolutions of up to 8000 by 8000 pixels.

Overall, LightWave 5.5 represents an outstanding price/performance value.

3D Studio Max 1.2 and 2.0

Released in 1996, Kinetix's 3D Studio Max was the first 3-D product written from the ground up for NT. It takes full advantage of NT's multithreading and features a unique architecture. Essentially, Max is a skeleton fleshed with plug-in components for modeling, materials, particle systems, and rendering. The Max plug-in Software Devel-



as rubberiness (they bounce) or weightlessness (they blow away), all without time-consuming key-frame animation. But plug-ins are expensive. Adding those mentioned costs more than buying Max.

Another innovative approach to modeling is the Object Stack, a listing system whereby every change you make to an object is accessible for further modification. The stack is collapsible, and you can animate virtually all the modifiers.

Max has achieved a dominant position in the NT 3-D scene. However, despite standard multimedia features (e.g., audio- and video-post tools), it lacks some features to compete successfully at the higher end, particularly in movie production.

RATINGS

TECHNOLOGY	★★★★
IMPLEMENTATION	★★
PERFORMANCE	★★★★

nails at every level of deep multilayered texture elements. This often-overlooked essential is the best we've seen to date.

Max 2.0 now includes dynamics and robust particle generation. A new scripting tool lets users create customized scripts and then generates an integrated working Max interface. This automates many tasks that previously took multiple steps.

With its free distributed rendering for up to 10,000 machines, Max 2.0 redefines professional 3-D price/performance.

Softimage 3.7

Softimage has long been Hollywood's premier 3-D character-animation program, used for everything from the elephants in *Jumanji* to the T-rex in *Jurassic Park*. The program consists of modules: Model, Motion, Actor, Matter, and Tools. It's updated quarterly.

The program comes as Softimage 3D or Softimage Extreme. Extreme adds a Particle System component and the Mental Ray distributed renderer. Additional Mental Ray licenses cost \$2495 per processor.

Softimage 3.7 for NT is essentially a shell written around the original Unix version. It's virtually identical to its Silicon Graphics counterpart in look, feel, performance, and Unix file management. This program is remarkably Windows-unfriendly.

Unlike its competition, Softimage supports only a few graphics modes (1024 by 768, 1280 by 1024, and 1600 by 1200 pixels) on one monitor. You have to convert

For Starters, a Simpler 3-D Package

While we've concentrated on the three production-level tools available for Windows NT/95, we'd be remiss not to highlight a good starter program: Caligari's trueSpace 3. Although it lacks some production-quality tools, trueSpace 3 is ideal for the beginner to 3-D. It has powerful modeling and dynamics capabilities, is inexpensive (a street price below \$600), comes with a good manual, is easy to get into, has a friendly (if not always intuitive) iconic interface, and comes

with several on-screen tutorials that demonstrate important features.

The program has a great deal of enthusiastic support from its user base, due in part to its 3-D Web design tools, such as a built-in browser, URL connectivity, and 3-D audio. These features make it an excellent Virtual Reality Modeling Language (VRML) world-building tool for beginners and experienced users. If you want to get your feet wet with 3-D, trueSpace 3 is worth a long look.

opment Kit (SDK) is free with the program, letting others extend its capabilities.

For example, Biped and Physique are powerful Max plug-ins for animating and skinning two-legged creatures. Animatek's WorldBuilder lets you build whole worlds with plants, bodies of water, and seasons, and composite them with Max files. Second Nature's Hypermatter gives objects and characters animatable properties such

To address these deficiencies, Kinetix added 1000 new features to version 2.0, which we tested in beta.

Max 2.0's extended capabilities include relational NURBS modeling, selective ray-tracing, expanded lighting controls, and comprehensive 2-D and 3-D snap controls. Of particular note is the retooled Materials and Asset Management Navigation component, which now features thumb-

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'matching job'
lookup.



Choose when
to reveal your
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standard image files (e.g., TIFF and TGA) to Softimage's own PIC format, although you can export Softimage files to major film and video formats, plus Virtual Reality Modeling Language (VRML) 2.0 and Nintendo 64. The program lacks audio features, and only the Mental Ray module is multithreaded.

We had difficulty installing both Softimage and its Flex/LM license manager, and they needed ongoing attention and handling. This was the only product for which we needed the company's technical help.

Many options are buried deep in menu layers, and the organization of features often seems random. Still, the program is surprisingly intuitive and fluid to work with, albeit with a steep learning curve.

Softimage's powerful modeling tools, though not as capable as those in Silicon Graphics' Alias, were the best of this group, featuring NURBS, patches, polygons, and metaballs. The ability to create bone hierarchies and skin them with envelopes or meshes is powerful and intuitive.

Likewise, the animation tools in Actor and Motion are best of class: powerful, precise, and easy to use. You can link sophisticated motion-capture controls to an external MIDI box to control complex body movements and facial expressions. The included particle package is robust.

The Matter module comes with an interactive 3-D paint program. However, its capabilities aren't up to 4D Vision's 4DPaint (which plugs into Max and Softimage), nor does it have the natural media brushes found in MetaCreations' Detailer.

The native ray-tracer in Softimage 3D is very fast and exceptionally efficient at anti-aliasing. Softimage Extreme's Mental Ray is a distributed, extensible, programmable ray-tracer that can provide looks and effects such as fur, volumetric lights, water, lens flares, and atmospheres.

For most BYTE readers, 3D Studio Max 1.2 wins on price, setup, and learning

TECH FOCUS

HARDWARE

PCs for 3-D: Do You Need a Second Mortgage?

It's a fact that 3-D animation applications are just about the biggest "cycle sponges" you'll find. High-end graphics tax every part of a system: 3-D-accelerated graphics cards for modeling and previews, hard disk space, and processor speed. To preview animations at true TV resolutions, you'll need a hardware-based video recording/playback system.

These hefty requirements have sold a lot of Alpha NT boxes over the last year, but even a Windows 95-based Pentium 133 with 32 MB of RAM will do for a start. A more realistic minimum for experimentation is a P-200, 64 MB, and Windows NT. If you can afford only one upgrade, consider a midprice video display card. You'll find that 3-D applications require a double-buffered display for decent speed; unlike 2-D applications (e.g., Adobe Photoshop), 3-D applications set up one frame while showing another. This doubles the display-card RAM requirements; you also need on-board space for textures. We suggest at least an 8-MB card, which will display a 1024- by 768-pixel picture in 32-bit color with room for textures. Our test equipment, running NT 4.0, Service Pack 3, went well beyond minimum requirements:

- a Compaq Professional Workstation 5000 with dual Pentium Pro 200s, 256 MB of RAM, and a pair of Elsa Gloria-L OpenGL-accelerated display cards with 16 MB each
- an Intergraph TDZ-425 with dual Pentium II 266s, 512 MB of RAM, and two dual Realizm V25-GTs, each with 16 MB of display RAM and a separate 16-MB texture cache
- a Carrera Computers Cobra EV56 with a 500-MHz Alpha, 128 MB of RAM, and a Dynamic Pictures Oxygen 402 display card with 16 MB
- a Dell XPS Dimension 200n (Pentium 200), running Windows 95 and NT, with 32 MB of RAM and an 8-MB Matrox Millennium II or a Number Nine 8-MB Revolution 3D

Even this high-powered hardware can take 10 minutes per frame to render complex scenes. If you're doing big graphics, you'll need big monitors. We used a 20-inch Nanao T2-20 plus the 21-inch Intergraph 21sd107, Compaq QVision 210, and ViewSonic P815, mostly in 1600- by 1200-pixel resolution. We also used the Intergraph InterView 28hd96 28-inch wide-screen monitor in 1920- by 1080-pixel resolution, a truly outstanding display.

curve. However, Max 1.2 is outclassed by Softimage in modeling, dynamics, and rendering. Like comparing a Range Rover to an 18-wheeler, each has a best use, depending on specific need. If you're out to produce movie-quality animation, Softimage justifies the effort and cost.

More 3-D in the NT Pipeline

As these three products show, the 3-D field is extremely competitive. In addition to 3D Studio Max 2.0, LightWave 6.0 is on its way, and the next version of Softimage, code-named Sumatra, promises to be NT-

friendly and have a new rendering scheme.

Other Silicon Graphics and Mac 3-D products such as Houdini, Strata 3-D, and Electric Image are in beta testing for NT. Also, low-priced products such as Macromedia's Extreme 3D, Caligari's trueSpace 3, and MetaCreations' Ray Dream 3D add powerful tools with every release. Even Alias's renderer works under NT, as will its next incarnation, code-named Maya.

Two trends are opening up the world of 3-D to new users. First, workstation-class graphics systems and software will continue to become faster, cheaper, and more powerful. Second, there will be lots of jobs for 3-D animators, as small production companies become competitive with larger houses. Also, many more design-related businesses can now do their own production in-house. Professional-level 3-D animation under NT is here to stay. **B**

PRODUCT INFORMATION

LightWave 5.5
\$1995, Windows 95, NT, Mac OS;
\$2995, Silicon Graphics or Sun
Newtek
Topeka, KS
210-370-8000
fax: 210-370-8001
<http://www.newtek.com/>
Enter 1007 on Inquiry Card.

Softimage 3.7
Softimage 3D, \$7995;
Softimage Extreme, \$14,000
Softimage, Inc.

Montreal, Quebec, Canada
514-845-1636
fax: 514-845-5676
<http://www.softimage.com/>
Enter 1019 on Inquiry Card.

3D Studio Max \$3495
Kinetix
San Francisco, CA
800-879-4233
415-547-2000
<http://www.ktx.com/3dsmax/>
Enter 1008 on Inquiry Card.

trueSpace 3 \$595
Caligari Corp.
Mountain View, CA
650-390-9600
fax: 650-390-9755
<http://www.caligari.com/>
Enter 1009 on Inquiry Card.

Also see the Web Exclusive version of Jerry Pournelle's Chaos Manor at <http://www.byte.com> for continuing coverage of 3-D graphics hardware and software.

David Em (davidem@earthlink.net) is an artist who's done animations for Apple and Universal Studios, among others. Alex Pournelle (alex@earthlink.net) is a computer consultant with Workman and Associates.

At last, a new OS for Power Macs and—soon—the Intel platform. By Peter Wayner

The Be-All-That-You-Can-Be OS

For the first one-and-a-half years of its existence, BeOS ran only on the slick multi-processing BeBox computers with the PowerPC architecture. Now, after an abortive courtship with Apple, Be is releasing an unbundled version of the OS that runs on most Macs with a PowerPC chip (Be promises an Intel version for next year). With this version, Mac owners can create a multi-OS system that makes it relatively easy to switch between OSes at boot-up time.

The front end of the BeOS side offers a Mac-like world with one icon for each file built on top of a Unix-like multi-threaded kernel. Each window represents a folder, and the folders are nested. Mac users will feel much more at home here than will people who are used to Windows Explorer.

Of course, there are some other differences, most of which are cosmetic. BeOS sports a sort of sketchy, dashed-off look, perhaps to attract the video and multimedia artists who are the system's primary target market. Apple's Mac OS 8 looks more polished and pressed by comparison. The biggest cosmetic difference is antialiased text for TrueType fonts (in PC format!). Built into the OS, this feature is a welcome advance. Most of the text just looks better and is easier to read.

Some of the differences between BeOS, the Mac, and Windows, however, are functional. A window that grows along the right-hand side, which is known as the *Deskbar*, lists the running applications in much the same way as the bar on the base of the screen in Windows 95. A start-button-like menu tree with applications and preferences also sprouts from the title bar of this window.

The biggest addition, called a *workspace*, is a simple mechanism for switching between nine desktops. You page between them by holding down the com-



Tracker, the main BeOS user interface, allows switching between applications à la the Windows 95 toolbar or the Mac OS toolbar.

mand key and pushing a function key. You can also drag windows between workspaces with a special graphical tool. This is a great advance for people who use their machines for multiple tasks and want to keep them organized. Most users will probably allocate one workspace to housekeeping tasks such as mail and put different applications in the others.

For the most part, though, the differences lie underneath the surface. BeOS offers preemptive multithreading. Be claims the file system and the graphics system are written as many lightweight threads that don't dominate the system, and my tests tend to confirm this. Measuring the degree of "threading" of an OS is always difficult. Slicing jobs into too many thin threads can result in deadlocking through resource conflicts if the threads end up jamming each other. I tested this by running many different pro-

RATINGS				
TECHNOLOGY	★	★	★	★
IMPLEMENTATION	★	★	★	★

grams at once and measuring the performance of the system.

In this regard, BeOS is rock-solid. Adding processes slows down the system, but there were no hiccups or glaring freezes during tests with multiple graphics and network programs running. Such performance is impressive and one of the main reasons that someone may choose to do their development on the system. This feature alone should appeal to people who try to juggle several large multimedia projects on a single machine.

Getting their hands dirty with the BeOS command-line interface may scare some people who are wedded to GUIs. You can open up a "terminal" window

and run Bash, a version of the Bourne shell, to monkey with threads and poke around the file system. Unix lovers will crave this window in the guts of the system, while it may put off others. Windows NT hides this level of detail by arranging for the output of these lower-level programs to go into scrolling lists. There isn't much functional difference, but Microsoft gets lots of marketing mileage by citing it as a difference between Unix and NT. Users who love Unix will be happy, and NT addicts will think it is all a bit primitive but still quite functional.

The 64-bit-wide file system means the OS can handle disk arrays as large as 18 TB, which should give the OS several years to grow. Multithreading reduces the impact of large copying jobs on productivity, as will *journaling*, a technique for lessening the dangers of corruption when two applications access the same file.

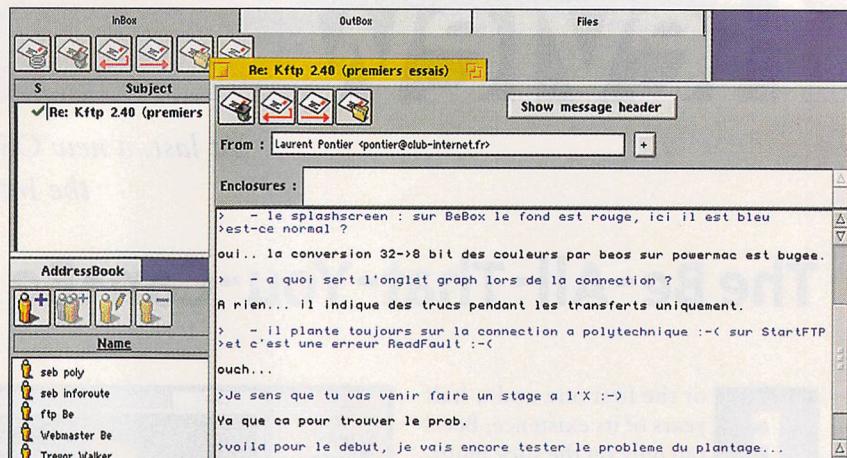
Some nice touches should make the system more friendly to folks developing interactive content for the Internet. The file system can share files via IP, and the file types are Multipurpose Internet Mail Extensions (MIME). There is also an integrated Web server for publishing files. Be added many of these extra details after the Internet frenzy began, which means

TECH FOCUS

BeOS File System

Several modern features of the BeOS file system really stand out. The first, called journaling, eliminates the need for time-consuming FSCK operations to check the validity of the file system. With journaling, the system maintains a separate record of all changes to the file block allocations table. If the system crashes, this journal makes it much easier to reconstruct the accurate table without surveying the entire disk.

Users can also store arbitrary attributes for each file under the BeOS file system and use the central index that BeOS builds for these attributes. Much more flexible than using DOS's three-letter-suffix technique or the Mac OS's hidden four-letter creator approach, the index lets programmers call up files quickly by asking for particular attributes. This is used, for example, by the mail system. It stores each e-mail message as a separate file with attributes listing details such as the sender, with the result that the programmers didn't have to write their own separate search facility into the code.



The MailIt mail client for BeOS uses the file-system attributes instead of building its own search routines.

that BeOS has one of the cleaner approaches to the Web. The greatest hole, however, is the lack of a Java implementation. There is a browser, but it doesn't do Java, at least not yet.

The greatest asset may be a version of the popular Metrowerks compiler that ships with the OS. You can read the source code for the demonstration programs and write new ones using the built-in system. Metrowerks makes the best compiler for the Mac. The company has plenty of experience compiling for both the PowerPC and Intel platforms.

BeOS vs. Unix

BeOS uses neither Mach nor BSD Unix, building up its own flavor with a new object-oriented library at the core. The libraries are close to Posix compliance, and Be claims that complete compliance is on the horizon.

Despite its Unix-like core, BeOS will disappoint those expecting to find all the bells and whistles of Linux or Solaris. Remote file sharing is available only as a third-party version of NFS, and the graphical interface doesn't support remote windows such as the X Window System protocol, though BeX provides a similar function.

Disappointing too is the lack of multi-user features: BeOS allows only one user at a time and lacks file-level security controls. Likewise disappointing is BeOS's lack of a scripting language.

Who Will Buy This?

I tested BeOS on an Apple Performa 6400. The process required reformatting one partition of the drive and then arranging to

boot up with a special Mac application. The transition went smoothly, though the Mac OS now complains that the partition is damaged. Aside from that, the machine now supports both OSes.

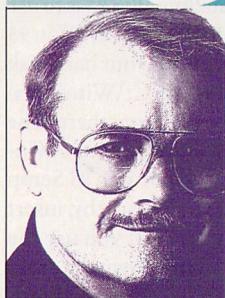
Just because BeOS is impressive technically won't necessarily make people want to use it. It offers all the multitasking sophistication of NT and much of the user-interface gloss of the Mac OS, but it is neither of those.

If you want to use either NT or Mac OS applications, you're out of luck. Be has announced that several important applications are available for the OS (a productivity suite and some multimedia applications), but the selection is still a far cry from the games and tools available on the mainstream OSes.

The best target may be programmers who need a workstation to roll their own programs that manipulate large volumes of data. The multithreaded nature of the OS simplifies running tasks in the background without degrading overall performance. I could see a small computer-animation shop choosing to build many of its tools on a Be platform, because it is so nicely functional. Tool builders and Unix heads may cling to BeOS, because it offers one of the best combinations of Unix and a modern GUI today. Anyone wedded to shrink-wrapped software, however, will have to wait. **B**

Peter Wayner is a BYTE consulting editor who lives in Baltimore. His latest book is Digital Copyright Protection (AP Professional, 1997), and his home page is <http://www.access.digex.net/~pcw/pcwpage.html>.

Chaos Manor



Fire Three for Effect!

Jerry builds a new dual Pentium Pro system from the ground up—and gets a case of the software-installation blues.

It was a wild month. It began with a weekend conference with the administrator of NASA. It ended with a real surprise.

We'd just gone down to the beach house in San Diego when we got a call from the Navy Public Affairs Office. The Navy's newest warship, the *USS Hopper DDG-70*, named for the late Admiral Grace Hopper, was sailing from Maine to San Francisco and would be stopping in San Diego. Did I want to sail with her up to the Golden Gate?

So, at Oh Dawn Hundred the next day, I was at the San Diego Naval Base, and off we went. Later that afternoon, Pacific Fleet asked the *Hopper* to assist in a real medevac operation, so instead of heading to San Francisco, we steamed west to get in position to let a helicopter from the *USS McClusky* land and refuel. This was the *Hopper*'s first cruise and the first night helicopter landing she'd done, but aside from a spectacular look at a zillion stars 150 miles offshore, it was all very much routine.

The *USS Hopper*, incidentally, is the first Navy ship designed to have women (the Navy calls them females) aboard in all capacities: officers, chiefs, and crew. Of some 340 people aboard, about 40 were females, and while I have some misgivings about this, I must say there was certainly no compromise in efficiency.

The executive officer rated the ship's ability to go to general quarters and clear for action at 74 percent (12 minutes) on the morning's drill, up from 70 percent the day before. This is pretty good for a ship that hasn't been commissioned yet. They figure they'll be at 100 percent by the time they reach Pearl Harbor, where the ship will be stationed.

When we came in at the Golden Gate, John Dvorak came aboard from the pilot boat. He was somewhat startled to see me already aboard.

The *Hopper* is filled with the electronic ability to track hundreds of air and sea objects, and needed it all to come into harbor. There must have been 50 sailboarders out in the Bay zipping about like gnats, as well as dozens of pleasure boats. Commander Thomas Crowley, the *Hopper*'s skipper, left coming in through the gate and alongside a San Francisco pier to his officers, but I did notice that while he was out on the weather deck enjoying the view, he had a small commercial

to take out the whole place, just the building where the installation-software programmers work.

We're building Fireball, a new dual 200-MHz Pentium Pro (the new one, with the on-board 1-MB secondary cache) system with the Micronics W6-LI motherboard, a Distributed Processing Technology (DPT) PM2044U SCSI RAID controller board with an RC4040 RAID/caching module (bundled with the DPT-RS3/UR RAIDstation Kit)—although the W6-LI has a perfectly good Adaptec SCSI built into the motherboard as well as the customary dual IDE, 64 MB of buffered nonparity extended data out (EDO)

It's a good thing the *USS Hopper* wasn't going to the Seattle area.

hand-held Global Positioning System (GPS) receiver.

Early BYTE readers will remember Grace Hopper, who had as much to do with computerizing the Navy as anyone I know of. She was also a formidable public speaker, as I found out when I twice had to follow her act. She was famous for giving away "nanoseconds": wire about a foot long cut to the distance electrons would travel in a nanosecond, and a good way to visualize why smaller is better in computer architecture.

More on modern military electronics another time; but it was a great way to end the month, and if the *Hopper*'s crew is a good example of our modern defense force, the country is in good hands.

It's a good thing the *USS Hopper* wasn't going to the Seattle area, or I might have tried to talk the skipper into bombarding Microsoft. I wouldn't want them

memory from Net Memory (since sold to Viking Components, at <http://www.vikingcomponents.com>)—when you're running a system this fast, it's important to get memory that meets or exceeds the specs—and a Teac CD-C68E 8x six-disc CD-ROM changer that you can configure to look like six different drives or one drive, as you like.

All this goes into a PC Power & Cooling ETA Solid Steel Tower ATX case with a Turbo-Cool 400 ATX power supply. It uses a PC Power & Cooling Dual CPU-Cool (H) fan on each chip; without those chip fans, the system would be useless. The Dual CPU-Cool (H) is actually two fans (PC Power & Cooling calls this fault-tolerant redundant cooling), and each is capable of keeping the chip running. I have relied on PC Power & Cooling components for more than a decade, and I have yet to be disappointed.

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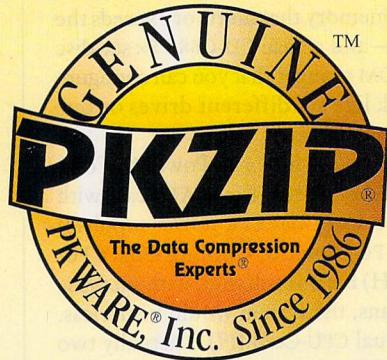
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Sound Blaster built in. Unfortunately, although it is built in, it runs off the ISA bus. Using ISA-bus devices in a PCI system can eat 5 percent to 20 percent of the system resources and slow things down surprisingly. As I write this, the only decent PCI-bus sound card is the Diamond Multimedia Monster Sound card (see the October Web Exclusive column), and while that's great for Windows 95 (Win 95) games, it doesn't work with DOS games or other DOS-based programs that won't run in a DOS box. For the moment, we have left the built-in sound card active, but we'll change that when there's a good alternative.

We also added a SOHOWare PCI 32-bit Ethernet adapter card from NDC Communications (<http://www.ndclan.com/>). We chose that because it was the cheapest PCI Ethernet card at Fry's when we went to buy disk drives for the DPT-RS3/UR.

We first set up Fireball with only one processor, so it made sense to bring it up with Win 95, in part because Win 95 is better at Plug and Play than Windows NT. Also, because while I eventually want to put NT 4.0 (and then a beta version of NT 5.0) on Fireball—the Pentium Pro chip is more appropriate for server applications, because the big cache makes it fast, but it doesn't have multimedia extensions (MMX)—I first wanted to test it under Win 95 and then Memphis, which is now officially Windows 98.

We have a beta version of Memphis running on RacingCow, a Gateway 2000 150-

nately we have plenty of examples around here, and the Teac CD-ROM changer came with DOS drivers. Now for Win 95.

The trick with installing Win 95 is to use DOS to copy the CAB files from the Win 95 directory somewhere onto your hard disk (the traditional place is C:\Windows\Options\Cabs) and install from there. The upgrade version of Windows wants a Windows 3.11 setup disk; when Win 95 Setup demands proof that you're worthy, insert that into the floppy drive. If you use the CAB trick, be sure to write down the exact path to those files. When you add hardware or make configuration changes, Win 95 Setup will demand your Windows installation disk—and once it gets drivers off a floppy disk, Setup does not have a browse button. You must type in the exact path to the files it wants.

The first time that happened was the first time this week I wanted to bombard the Microsoft campus. It wasn't the last.

I got Win 95 installed just fine, but then came time to make the network happen—and it just wouldn't work. I got every kind of screwy error message. I tried telling Device Manager that there wasn't any network card, so it would discover it at the next boot-up; alas, it would almost forget, but somewhere in the dark recesses of the imbecilic registry, it remembered just enough to foul things up. I physically removed the network card; same problem. Win 95 just couldn't forget.

After 3 wasted hours, I decided there

I tried telling Device Manager that there wasn't any network card.

MHz Pentium system, and it's pretty cool; I think I am going to like the final version. On the other hand, all the stories I hear are that if you have 32 MB or more of memory, you will get all the advantages of Memphis and then some with NT 5.0 Workstation. We'll see.

It's as a server that the DPT controller with its RAID capability comes into its own, so more on that after we add the second processor and convert to NT.

Bringing the system up was a breeze. I used DOS 6.22 to boot up, format, and SYS the hard disk. I installed Norton Commander to make it easier to manage and edit the CONFIG.SYS and AUTOEXEC.BAT files. As always, I'd forgotten how to set up DOS and a CD-ROM drive, but fortu-

was only one thing to do: remove the network card, reformat the hard disk, and reinstall Win 95 from scratch without the network card.

That worked, except that this time I forgot the CAB trick, so I was installing from CD-ROM. I got it all working without a network. Shut down. Install the network card. The system came up, detected new hardware, and asked for the drivers. I said, "Have disk." It found the drivers on the floppy disk and came back—and reported that it could not find the Win 95 installation disk.

Oh, it knew to look in the E (CD-ROM) drive. What it didn't know was to look in the Win 95 subdirectory of that CD-ROM. Worse, I had forgotten what subdirectory

the files Setup wanted were hiding in—and there was no browse function. You either give it the proper subdirectory or cut your throat. If I'd had command of a missile destroyer at that moment, I really would have been tempted to fire three for effect.

What I did was remove the CD-ROM, put it in another machine, look at the directory structure, figure out that it wanted E:\WIN95, put the CD-ROM back in, and type in the path. After that, everything went swimmingly. In minutes, I had a very fast machine connected to my network.

By fast, I mean, like WOW! fast. With that SCSI DPT drive with its big cache, the new Pentium Pro 200 chip, and Number Nine's Revolution 3D video board, this machine screams. Unless you need MMX, Pentium Pro may well be good enough, especially if you can get it as an upgrade to an existing system.

Larry Aldridge says the additional onboard cache works best in systems with either dual or quad processors, which primarily means NT servers, where you don't need MMX anyway. In a few months, there will be Pentium II chips with a larger cache, and those will probably be faster than the Pentium Pro 200s we have, but for just now, this may be the fastest NT server going.

Alex says my network installation problems may have been due to getting a no-name Ethernet board. We don't recall having similar difficulties with 3Com Ethernet boards.

Now for some tests. The problem is, how do you test the system, and more to the point, what drivers do you use? That is, the Revolution 3D board came with two sets of drivers: those you ought to use to run programs, and a set optimized for the standard benchmarks magazines use. The benchmark-optimized drivers will spit out triangles at some hideous rate, but the result doesn't look nearly as good as the slightly slower but gorgeous results with their standard user drivers. Benchmarks govern many purchase decisions, and they probably shouldn't. It's easy to optimize drivers for benchmarks.

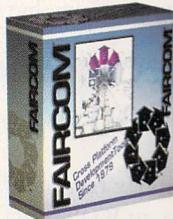
Incidentally, when Phil Parker from Number Nine was showing off the Revolution 3D, one of the tests he was proud of was performance on good old WinTach, which does after all test some practical uses rather than just the ability to spit triangles.

The problem is that WinTach is quite sensitive to color depth and resolution. Fireball, with the Revolution 3D, has a

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WinTach of 368, as compared to Cyrus, the Cyrix P-166, with 128. However, if I move Cyrus from 256 colors to 32,000, the WinTach goes up to 300 (78 on word processing). I can recall when a value of 30 was blazing speed. Princess, my dual-processor Compaq workstation, has a WinTach of 245, but a story goes with it. Apparently because of the big monitor, the word processing part of WinTach goes really slow and gets a score of 12.3; but everything else is blazingly fast.

In any event, we used the standard drivers, and the Revolution 3D is clearly good enough. Indeed, at \$300, it may be the best way to "upgrade" an older system. We have an opera tonight, so it will be a day or so before I get to it, but I intend to take that Revolution 3D out of Fireball and install it in Cyrus and Princess to see if there's noticeable improvement. I think there will be improvement; noticeable is another matter, since both are pretty fast at what I do.

I did have one major glitch. One game that I use to test system speed is Micro-Prose's This Means War. The game remained fun for longer than many, but more important, when you get lots of objects on

the screen, it slows down enormously.

This Means War will run only in 256 colors. Number Nine's HawkEye software changes resolution and color depth on the fly without rebooting the system; but if you use that software, This Means War blows up in odd ways. It runs fast, faster than I have ever seen it—one of the complaints reviewers had was that the game was slow, but with this machine it isn't—but weird stripes appear. After a while the message fonts change, not only in the game, but after you exit. The only solution is a reboot.

If you change to 256 colors and reboot, the game runs without problems, but it's

for not including something they didn't believe in, so the capability is there now, but they aren't surprised that it can cause problems.

What I have done is to change colors on the fly, but I leave the HawkEye program open to the "resolution exchange" tab. When my game graphics get screwed up, the game is still playable; but when I am tired of the lousy graphics, I save and exit.

Then I go to HawkEye. It's unreadable—when the graphics go bad inside the game, they're still bad when the game has gone away—but I have memorized where the color-depth buttons are. I punch any one of them—it doesn't matter which—

I can recall when a WinTach value of 30 was blazing speed.

no longer spectacularly fast. It's fast enough, but there's no WOW! factor. Number Nine boards formerly didn't have a "change color depth on the fly" capability, because that isn't really supported by Win 95, and you have to trick the OS to do it. They got weary of being condemned

and apply, which fixes everything. Then I use HawkEye to go back to 256 colors, load the game, start with the saved game, and go. The system is so fast that this takes almost no time. And Alex has found that we can use Alt-Tab to get to the HawkEye control panel without exiting the game at all, and that will refresh things, too.

I haven't had any other problems with the Revolution 3D, and I wouldn't have that one if I didn't want to avoid rebooting every time I play a 256-color game.

David Em has been working with the Revolution 3D board (see "Number Nine's New Spin: Revolution 3D," November BYTE), and he likes it for professional graphics. It's certainly good enough for games. As an all-around upgrade to medium speed—say 150 and higher Pentium systems—it looks like a very good bet. The 2-D graphics capability is better than some of the far more expensive boards we have tried, and the 3-D is quite good for the price. More after a bit more testing, but I like it just fine so far.

Another candidate for a games update board is the STB Velocity 128 3-D board. This thing screams in both 2-D and 3-D. It has S-Video and SVGA-Video output as well as composite video you can feed to your TV. With a 21-inch monitor, it will do up to 1600 by 1200 pixels at 65,000 colors. There are NT as well as Win 95 drivers, and it supports DirectX. It's a PCI-bus card, and on benchmarks and features, it compares quite favorably to both the Matrox Millennium and the Diamond Monster 3D. Eric Pobirs, our intern, has been quite fond of it. He will probably have a full

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report shortly, on the BYTE Web site or mine, <http://home.earthlink.net/~jerry>.

It is a game board. That is, it has 4 MB of synchronous graphics RAM (SGRAM) standard, but that's all you can put on it. It's more than enough for games, but it's on the low side for professional (especially 3-D) work. It is \$100 cheaper than the Revolution 3D and has the video output ports; if you're mostly interested in games, this board will upgrade a slower system something wonderful. If you need professional quality, the Number Nine Revolution 3D looks good to us. If what you want is games (as well as standard stuff like word processing and Internet crawling), look into the STB Velocity 128.

I really like Teac's CD-C68E CD-ROM changer. No carriers, naturally. It comes with software that will let it play CDs. I never do that: a good stereo is cheaper than a high-end computer and plays music better. I gather some people do like to play CDs through their computer, and that certainly works.

As I said earlier, you can configure the CD-C68E to look like one drive or six. If you make it one drive, there's a program to let you select which disc is mounted when you access the drive letter. It's all intuitive, and it all works. I'm still experimenting with the "one drive letter" configuration accessed through the network: so far, I find I must go to the machine it's installed on to change accessed discs. There may be a way I haven't found. There's no difficulty at all if you configure it so that each disc has a separate drive letter and share them all. Recommended.

After we got Fireball going, I made the terrible mistake of installing Helix's Nuts & Bolts.

The first problem is installation: Nuts & Bolts wants a serial number in addition to the installation CD-ROM. While the registration card gives you the right digits in the right order, the program wants that with spaces and dashes—and it is not printed that way. It took 5 minutes of increasingly infuriated experimentation to get Nuts & Bolts to install.

When it did, it apparently spotted that I have a network and must have assumed Fireball has a modem, although as yet it doesn't. I say this because whenever I bring up Fireball, Nuts & Bolts trundles a while and then informs me that it can't update itself, OK? Until you acknowledge that OK,

you won't get anything else done. Then it does a bunch of other stuff, finally putting up gauges and toolbars similar to what Norton System Doctor does. All that works, I guess. I put it that way because I didn't do much testing.

What you don't want to do with Nuts & Bolts installed is simply turn the machine off without a proper shutdown. I seldom do that, and in fact all my systems are on either Clary or APS uninterruptible power supplies (UPSes). However, it's a necessary test for any system because it's going to happen sooner or later, if for no other reason than that sometime your system will be locked up and require a hardware reset. So, once I got Fireball working and networked and running Nuts & Bolts, I hit the switch and went to bed.

The next morning I turned Fireball on, and when it asked to log in to the network, I hit the Return key. After a while, I realized that nothing was happening and instantly saw why: Fireball is on a test stand in the middle of the room, and the Ethernet cord runs across the floor. While the machine was off, I had disconnected the Ethernet so that the housekeeper wouldn't trip on it, and I'd forgotten to reconnect.

No problem, thought I. I'll just plug in the Ethernet cord. Alas, still nothing happened, and after a while it was pretty certain that nothing would happen. Hardware switch time. Be sure the Ethernet is plugged in. Turn on the system.

It died spectacularly. First, up came Protected by Bombshelter, one of the components of Nuts & Bolts. Came up and

stayed up; the machine was locked up with that. Turn it off again and pray. This time, it was stuck on some other component of Nuts & Bolts. Two hardware resets later, I got control of the system.

It was incredibly slow. I mean, Windows 2.0 on a 386 type slow. Unusably slow. Shut down and reboot yet one more time. This time, it hung up on that message about not being able to upgrade, and it was still slow. Not quite as slow as before, but still slow compared to a good Pentium system. At least I had control, so I created an "old start" folder, moved all the Nuts & Bolts program icons out of the start-up folder to that, and rebooted once again.

System speed was fine now. For a test, I moved the Nuts & Bolts stuff back to the start-up folder and rebooted yet once more—I do this silly stuff so you won't have to—and this time everything came up properly with the proper speed. Then I ran a few games that I know will crash Win 95, had to do hardware reset, and brought the system up with and without the Ethernet cord attached. The results were predictable: so long as the Ethernet hardware was properly connected, the system came up fine. Without it, Nuts & Bolts caused some real problems.

Meanwhile, Eric was using Nuts & Bolts on another system. When he wanted to change some of its components, it demanded the serial number: and lo!, this time, it wanted a different configuration of spaces and dashes from the one it demanded at installation!

At that point, I concluded enough was

enough and removed Nuts & Bolts from all my systems. When they get the installation bugs fixed, I may look at it again; but, in fact, I didn't see any advantage over CyberMedia's First Aid or Norton System Doctor, neither of which has ever caused me as much trouble as Nuts & Bolts just did. Not recommended.

The game of the month is Strategic Simulations' Pacific General. It's one of the General series, which means it is optimized for playability rather than realism, so the sea battles like Midway don't go anything like they did in the real world. On the other hand, they're fun, and the land battles work fairly well given the limits of the General engine. You won't get sucked in the way MOO got you, but I found myself playing later into the night than I'd intended.

The book of the month is by Lance Banning, *The Sacred Fire of Liberty: James Madison and the Founding of the Federal Republic* (Cornell University Press, ISBN 0-8014-3152-2). This is quite the best political biography of Madison you will ever see, and a wonderful analysis of Madison as both framer and one of the authors of *The Federalist*. There is today all too little attention paid to the relations between the national government and the states, and more's the pity.

The computer book of the month is the Waite Group's *Visual Basic 5 Interactive Course* (ISBN 1-57169-077-8), which comes with a Web-based course and access to both frequently asked questions and on-line expert help. It has the only explanation of class objects I've been able to understand and is pretty complete up to intermediate level. It probably isn't the only book you will need to learn Visual Basic 5, but coupled with *Teach Yourself Visual Basic in 21 Days* (Sams, ISBN 0-67230-978-5), it will carry you a long way.

Now I have to go build up a system to send to my son Phillip. All about that next month. **B**

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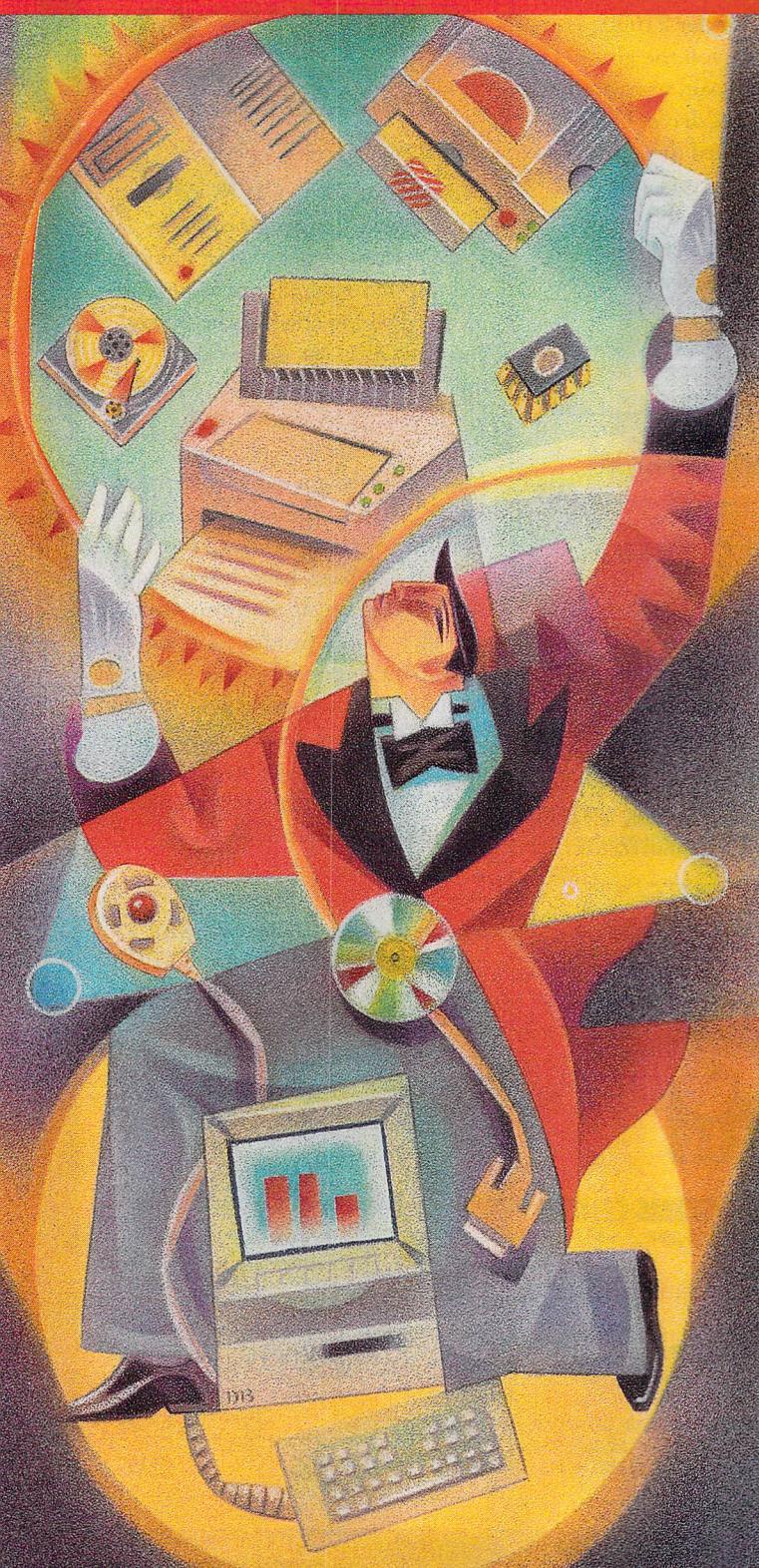
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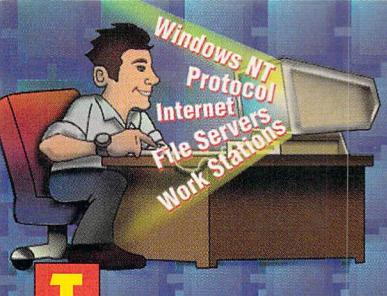
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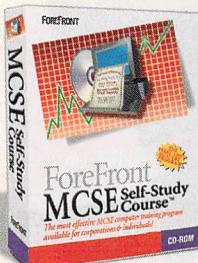
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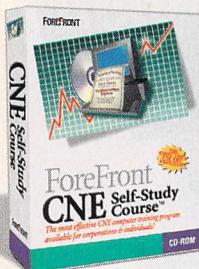
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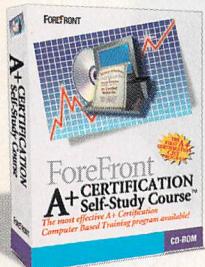
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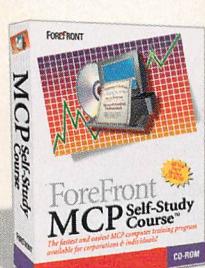
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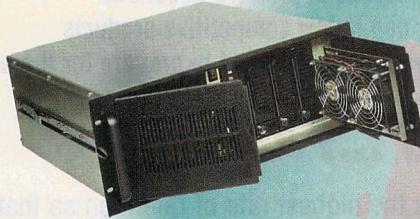
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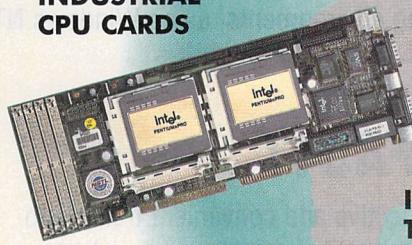
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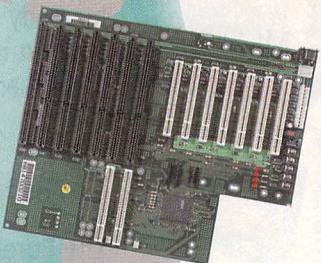
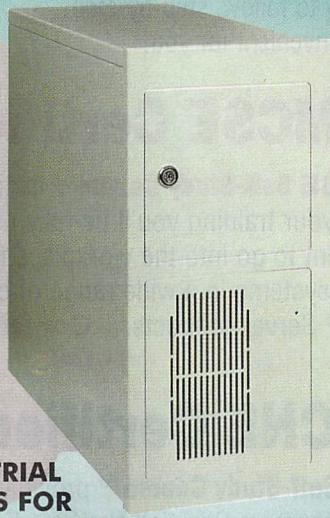
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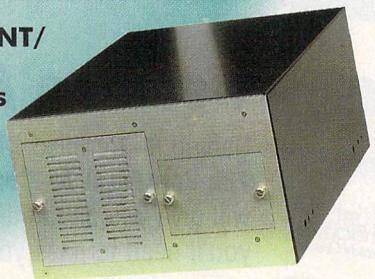


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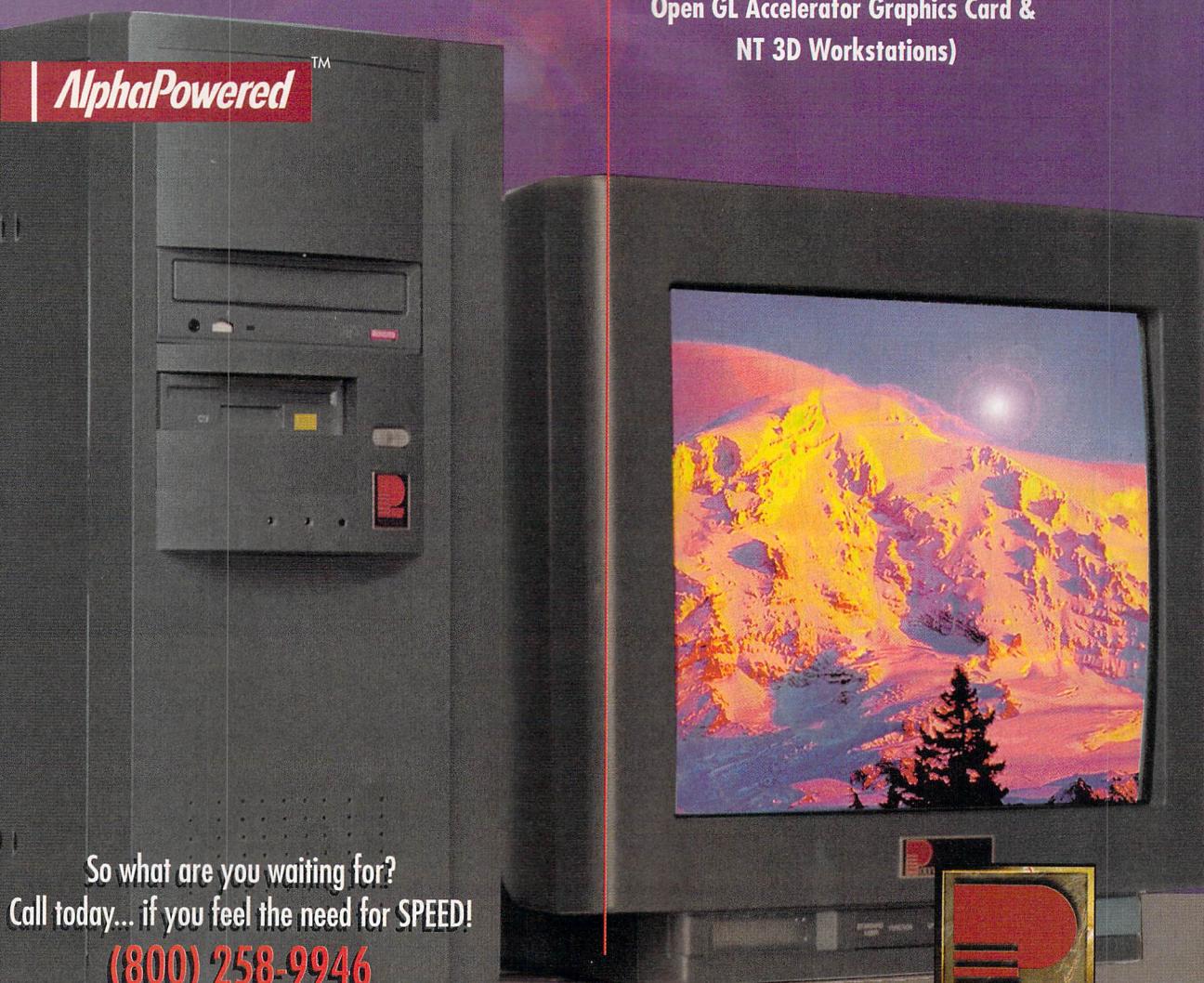
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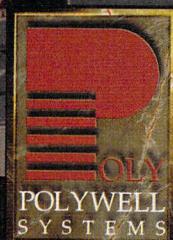
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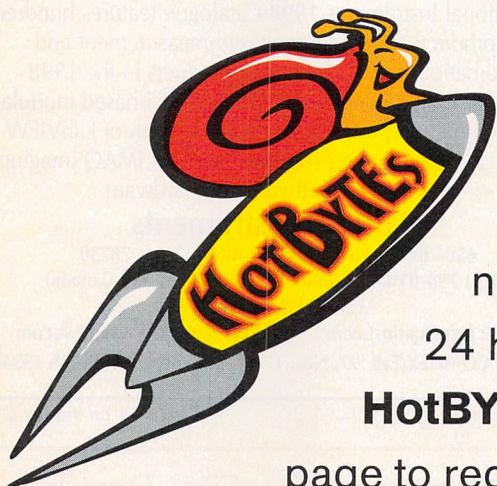
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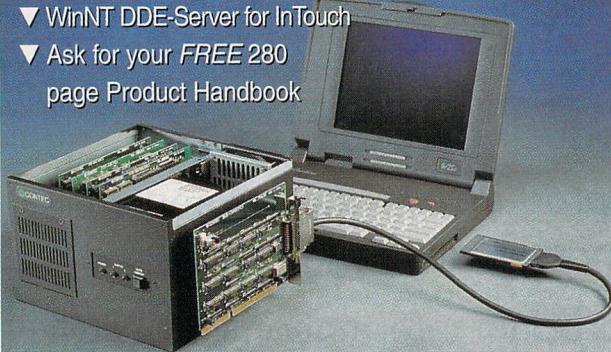
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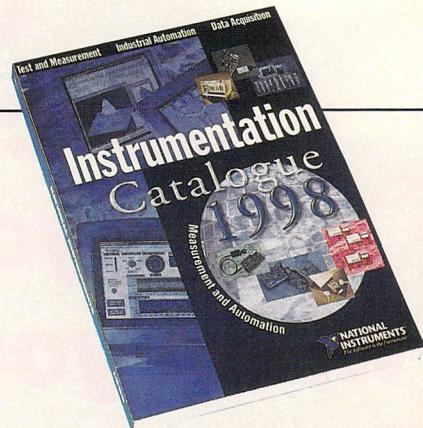


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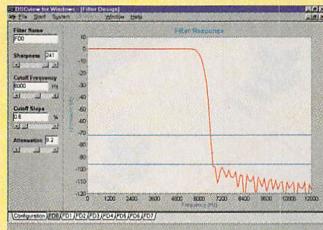
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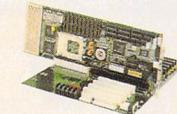
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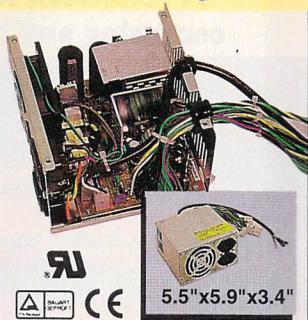
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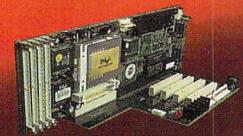
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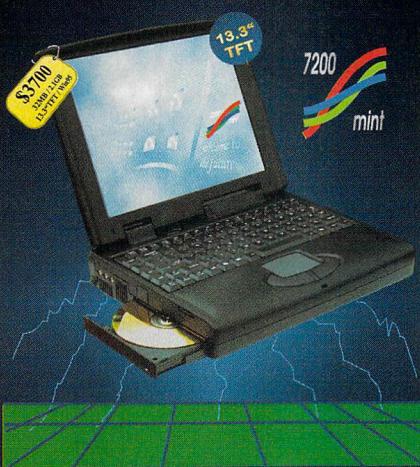
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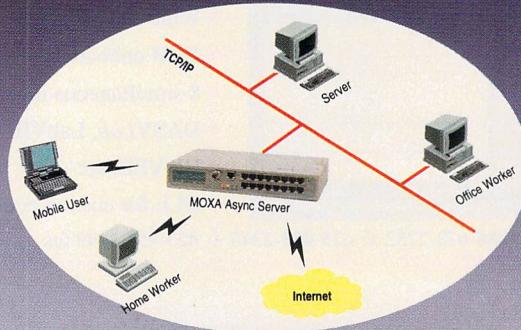
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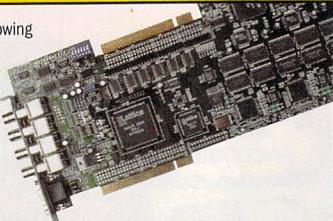
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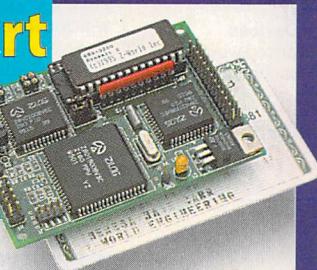
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DEADLINE: Ad copy is due

approximately 2 months prior to issue date. For example: November issue closes on September 15. Send your copy and payment to:
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 Magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information please call Mark Stone in BYTE sales at 603-924-2533 or FAX: 603-924-2683.

RATES (January 1997)

	3-5 issues	6-11 issues	12 issues
1 ad	\$820	\$790	\$690
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	3 ads/issue	"	620
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	A			E			P				
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*	BYTE ON CD ROM	116	800-924-6621	84-85	ICP ACQUIRE	155	800-500-4138	127	SAMSUNG	29	
*	BYTE PUBL STATEMENT	143		117	INTEGRIX INC	49	800-300-8288	454-455	SEH COMPUTERTECHNIK GMBH	44IS 23	+49-521-94226-0
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*	BYTE SUB MESSAGE	159		90	JK MICROSYSTEMS	157	510-236-1151	128	STATSOFT	97	918-749-1119
*	BYTE WEB SITE	19	http://www.byte.com		K				T		
	C			118-119	KINGSTON	39	800-435-0670	102-103	TECHNOLAND	155	800-292-4500
431-432	COMPEX INC	15	714-630-7302		M			*	TELE.COM	42-43	
*	COMPUTER ASSOCIATES	2-3	888-864-2368	*	MCGRAW HILL FIELD SALES	44IS 16		89	TERN INC	157	916-758-0180
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435-436	DISTRIBUTED PROCESSING TECHNOLOGY	44IS 15	407-830-5522	86	NEATO LLC	156	800-984-9800				
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New Product Information Service:
www.byte.com/hotbytes/hotbytes.htm

INQUIRY NO.	PAGE NO.	INQUIRY NO.	PAGE NO.	INQUIRY NO.	PAGE NO.	INQUIRY NO.	PAGE NO.
	A						
993	Accent Software 163	Digital Equipment 24, 55		M	103	Q	Quantum Asia-Pacific 44IS 3
	Acer 44IS 13	Digital Island 65		Macromedia 103		R	Radguard 44IS 18
	Acme Laboratories 103	Distributed Processing Technology 139		Marimba 103		S	Rockwell 24
	Actra 116C	Dragon Systems 55, 103		MasterCard International 67		T	Roke Manor Research 44IS 3
	Adaptec 44IS 3	Dynamic Pictures 103		1017 Maxtor 163		U	Samsung Telecommunications America 47
	Adobe Systems 103	ElecVision 44IS 3		997 McAfee 163		V	Satyam Infoway 44IS 3
	Advox 44IS 9	Epson 103		Megisoft 75		W	ScanSoft 163
1030	Alaska Software 44IS 18	Equisys 44IS 9		Metroworks 103		X	Seagate Technology 103, 44IS 3
	AMD 80	Extended Systems 75		1016 Micron Electronics 163		Y	Security Dynamics 67
	American National Standards Institute 57			1047 Micronics Computers 139		Z	Siemens Nixdorf 44IS 18
	Amicus Networks 65	F		978 Micropolis 163, 44IS 3			SilverStream Software 116C
	Analog Devices 24	Fenestrae 44IS 9		1006, Microsoft 45, 93, 99, 103, 118, 133, 163, 92NA 1			Sonic Foundry 103
	Apple Computer 103	Fulcrum 163		1019, 1073, 1095			1014 Sony 163
	Artic Technologies 55						1046 STB Systems 139
	Ascend Communications 93	G					1053 Steljes 44IS 18
1078	AST Computer 124	GE Information Services 75					1044 Strategic Simulations 139
	Asustek Computer 44IS 13	Group 44IS 18					991 Sun Microsystems 103, 163
1071	AT&T Wireless Services 47	GTE Internetworking 75					1004 , 1005 Symantec 103, 163
	Automotive Industry Action Group 65	Guideware 163					1040 Syntha-Voice Computers 55
1021	Avantis 44IS 18	GW Micro 55					1040 Teac America 139
988	Axonix 163	H					976 , 1085 TechniSat 44IS 3
	Bay Networks 93	Haht Software 118					976 , 1085 Tektronix 124, 163
	B	1048 Helix Software 139					
1011	Be 137	Henter-Joyce 55					
	Bellcore 67	1025 Hermstedt 44IS 18					
	Boole & Babbage 93	990, Hewlett-Packard 93, 124, 163					
	Borland International 103	1015, 1080					
1082	Boundless Technologies 124	1029 Hirschmann 44IS 18					
	C	Hitachi 24					
	Caldera 103, 109	I					
984	California Graphics & Peripherals 163	987, IBM 24, 93, 163, 44IS 3, 116C					
1009	Caligari 103, 133	994 IBM Direct 55					
	C-Cube Microsystems 59	IBM Personal Computer 103					
	Centaur Technology 24, 80	iCat 116C					
	Charter Systems 65	J					
996	CheckPoint Software 163	1090 Information Builders 118					
	Chorus Systems 103	1038 Inso 44IS 18					
	Chromatic Research 80	981 Intel 14, 24, 80, 163					
	Cisco 93	985 Intergraph 103, 163					
995	Citadel Technology 163	Internet Engineering Task Force 67					
	Citrix Systems 103	1054 Intertex Data Systems 44IS 18					
	Cleva 44IS 13	1001 IntraNet Solutions 163					
	Click Interactive 75	1026 Investix SA 44IS 18					
	Commerce One 116C	Iona Technologies 103					
1039	COM: Computer & Motion 44IS 18	1088 ISG International 132					
	COM:ON 44IS 9	K					
1079	Compaq Computer 124	JASC 103					
	Computer Associates 93	L					
	Connectix 103	1008 Kinetix 103, 133					
1055	CS Technologies Informatiques 44IS 18	Kurzweil Applied Intelligence 55					
	Cyrix 80	989 Lexmark 163					
	D	998 Lotus Development 118, 163					
	Data Storage Institute 44IS 3	1091 Lucent 24					
1024	Davis 44IS 18	E					
1034	DB Research 44IS 18	1042 Distributed Processing Technology 139					
	Differential 75	Dynamic Pictures 103					
		1017 Maxtor 163					
		997 McAfee 163					
		1016 Micron Electronics 163					
		1047 Micronics Computers 139					
		978 Micropolis 163, 44IS 3					
		1006, Microsoft 45, 93, 99, 103, 118, 133, 163, 92NA 1					
		1019, 1073, 1095					
		MicroTalk 55					
		Mitac International 44IS 13					
		Mitsubishi Electric 24					
		1071 Mitsubishi Personal Mobile 47					
		Communications					
		1002 Mustang Software 163					
		NetObjects 118					
		Netscape 67, 103, 92NA 1					
		Communications					
		1084 Network Computing Devices 124					
		Network TeleSystems 75					
		1031 Neural Computer Sciences 44IS 18					
		1032 Neuron Data 44IS 18					
		Newmonics 103					
		1007 Newtek 133					
		977 Nikon Optical 163					
		Nortel 44IS 9					
		Novell 103, 92NA 1					
		1045 Number Nine Visual Technology 103, 139					
		Nvidia 80					
		1096 ObjectShare 118					
		Octel Communications Europe 44IS 9					
		OEM Metec 44IS 3					
		983 Okidata 163					
		1089 OpenLink Software 132					
		Open Market 75, 116C					
		Oracle 116K					
		1028 Orckit 44IS 18					
		P					
		1013 PalmSun Software 163					
		1041 PC Power & Cooling 139					
		1061 PCSL 44IS 18					
		1023 Pericom Desktop Networks 44IS 18					
		Play 103					
		1074 Poet Software 113					
		The Productivity Works 55					
		Psion Computers 103					

IS pages appear only in the International edition. NA pages appear only in the North America edition. C and K pages appear only in the Reseller edition.

What's New

Hardware

A look at MetaCreations' Ray Dream 3D. Also: Tektronix's color printer, new storage solutions, and better OCR from ScanSoft.

PREVIEW



Phaser 380

\$7995

Enter 976
on Inquiry Card.

Tektronix, Inc.

Wilsonville, OR
503-682-7377
[http://www.tek.com/
color_printers/](http://www.tek.com/color_printers/)

Not Quite Ready for Prime Time

Tektronix is promoting the Phaser 380 solid-ink printer as a way for design departments and offices without a color laser to produce full-color, 11- by 17-inch bleeds for proofing and quick checks of creative concepts. Solid-ink technology is similar to the technology used in laser printers but has fewer consumables, uses four waxy blocks of ink instead of electrostatic toners, and offers vivid colors, good color-matching capabilities, and a low per-page printing cost for a color printer. But if the Phaser 380 has the speed and color capabilities of a laser, why isn't it ready to do more than proofing?

The main answer is resolution. Some inexpensive ink-jet printers can match the resolution of the Phaser 380. Another issue is that the Phaser 380's text-graphics printing (e.g., calligraphy and logos) is poor, with the letters looking blurred and smudged. Also, one odd property of solid ink is that you can smear and scrape the ink right off the page with a fingernail, which undermines the durability of a print.

What this solid-ink printer does offer is rich color and pretty good speed, especially when printing 11-by-17 full-color bleeds. The Phaser 380 printed an 11-by-17 PostScript file in less than 1½ minutes. But the printer's limitations became apparent when I ran the same PostScript image on the Phaser 380 and on a Xerox Majestik 5765 color laser printer. The laser printer captured levels of detail that the Phaser 380 simply could not produce.

For \$7995, the Phaser 380, with its rich color, good speed, and wide-format capabilities, is a versatile printing option—if it's not ready to be your go-to-production printer.

—Jason K. Krause

Multimedia

Write and Overwrite Faster

PRODUCTION AND POST-PRODUCTION FOR audio, video, and various multimedia applications are smoothly accomplished with the Nikon Beluga AV direct-overwrite MO drive (\$2295). This drive supports 4-MBps data transfer rates and 10-MBps burst transfer rates, and it writes to 2.6-GB, 5½-inch removable cartridges. The removable disks, which cost \$90 each, make it possible to overwrite data without erasing old



data first, which increases the write performance of the drive and prevents distortion.

Contact: Nikon Optical Storage, Belmont, CA, 650-508-4674; <http://www.mo-nikon.com>. Enter 977 on Inquiry Card.

Systems

Potent New PCs

SONY's VAIO MULTIMEDIA TOWER computers have been expanded to offer more power for the desktop environment. Starting at \$2399, these 266- and 300-MHz Pentium II-based systems feature Accelerated Graphics Port (AGP) graphics and PCI Audio to make digital imaging and other multimedia functions easier. The PCI Audio controller (a 32-bit ESS Maestro II), the new 3-D AGP add-in card from ATI, 4 MB of

SG video memory, MPEG-1 video, and 32/64 MB of SDRAM all contribute to potent multimedia performance in a PC.

Contact: Sony ITA, San Jose, CA, 800-476-6972 or 941-768-7676; <http://www.sony.com/pc>. Enter 1014 on Inquiry Card.

Hard Drives

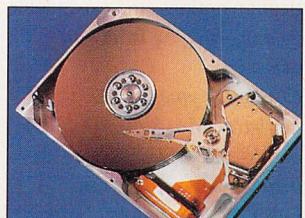
Multimedia-Application Hard Drives

THE NEWEST MICROPOLIS TOMAHAWK 3½-inch disk drives can store up to 20 GB and, according to the vendor, can deliver 10-MBps data transfer rates with no dropped frames for video and multimedia applications. The Tomahawk AV Gold 20 (\$2245) can store up to 20.27 GB of data with its 2-MB cache buffer and has a 7200-rpm spindle speed and Ultra or Ultra2 SCSI connectors.

Contact: Micropolis, Chatsworth, CA, 800-395-3748 or 818-709-3325; <http://www.micropolis.com>. Enter 978 on Inquiry Card.

Faster PC Hard Drives

OFFERING CAPACITIES FROM 2.1 TO 8.4 GB, the DiamondMax 2160 brings new features to the desktop PC for 3½-inch EIDE hard drives. Features such as magneto-resistive heads and a digital signal processor make it possible to lower seek times, which



Maxtor estimates to average 9.7 ms. The 8.4-GB model costs \$499.

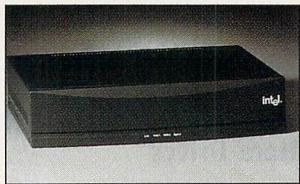
Contact: Maxtor Corp., Longmont, CO, 800-262-9867 or 303-651-6000; <http://www.maxtor.com>.

Enter 1017 on Inquiry Card.

Networking

Virtual Private Networks

YOU CAN ESTABLISH VIRTUAL PRIVATE NETWORKS over frame relay, dedicated leased lines, or ISDN via a local connection to an Internet service provider.



vider with Intel's Express Router (from \$1299). The device offers encryption for IP packets transmitted over the Internet, as well as frame-relay encryption, IPX filtering, and support for PC Card modems.

Contact: Intel Corp., Santa Clara, CA, 800-538-3373 or 503-264-7354; <http://www.intel.com>.

Enter 981 on Inquiry Card.

Extend Network Access

SMALL OR BRANCH OFFICES CAN GET THE same network access as large offices with the Xyplex Maxserver, a fixed-port access server. Starting at \$1995, the Maxserver, which has four or eight ports and speeds up to 115.2 Kbps, supports IPX, TCP/IP, LAT, PPP, SLIP, CSLIP, and remote and local dial-up access. It offers a variety of local and remote management options, a graphical configuration tool, security-authentication options, and expandable memory ranging from 4 to 6 MB of RAM.

Contact: Xyplex Networks, Littleton, MA, 800-338-5316 or 978-952-4700; <http://www.xyplex.com>.

Enter 980 on Inquiry Card.

RAID Controllers

THE DAC960PJ LEVEL 5 RAID controller (from \$1050) is capable of 2400 I/O per second, which Mylex claims is a 118 percent increase over its previous top-of-the-line controllers. RAID controllers are used in building enterprise-level server and storage subsystems, and this PCI-to-SCSI controller has Hot Plug support and a 32-bit, 66-MHz RISC CPU with several read/write cache options to free up host CPU cycles and keep systems on-line.

Contact: Mylex Corp., Fremont, CA, 510-796-6100; <http://www.mylex.com>.

Enter 982 on Inquiry Card.

Servers

Small, Smart Print Servers

THE MARKETNET PRO PRINT SERVERS BRING simplified configuration and management capabilities in a small form factor with support for all major



network protocols and OSes. They automatically assign IP addresses and inform the user about a printer's status. With 1 MB of flash memory, it's possible to directly update network configurations. The MarketNet Pro 3 (\$325 for 10/100Base-TX or \$500 for Token Ring) comes with two parallel ports and one serial port; the MarketNet Pro 1 (\$225 for 10Base-T and \$250 for 10Base-T/2) has one parallel port.

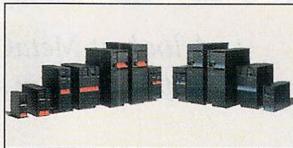
Contact: Lexmark International, Inc., Lexington, KY, 606-232-2000; <http://www.lexmark.com>.

Enter 989 on Inquiry Card.

Get More from the Web

IBM HAS OPTIMIZED THE AS/400E SERIES of servers (\$7995 to \$1,250,000)

for commercial Internet applications by adding more processing power than the previous AS/400s



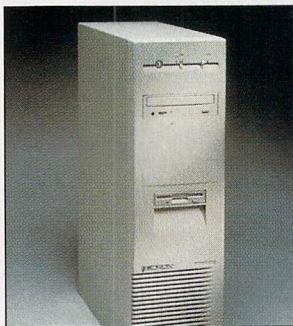
had, a new OS, and embedded Internet-user and validation-list access control. An AS/400e with eight 12-way microprocessors provides 4.6 times the throughput of similar, earlier AS/400 models. Firewall solutions are available on processor cards, eliminating the need for separate firewall servers. The AS/400 version 4, release 1 OS comes bundled with the server.

Contact: IBM Corp., White Plains, NY, 416-383-5152; <http://www.ibm.com>.

Enter 987 on Inquiry Card.

A Complete Server for Small Networks

SOME SMALL NETWORKS REQUIRE FULL-featured servers; for \$4389, the NetFrame LV2000 offers single or dual 233-, 266-, or 300-MHz Pentium II CPUs with a 512-KB cache and Microsoft's NT Server 4.0 with a 10-seat license. With 10 drive bays, up-to-9-GB hard drives, and one ISA and four PCI expansion slots, the LV2000 server is able to grow with your business. Integrated Fast Ethernet network-interface cards and Intel's LANDesk



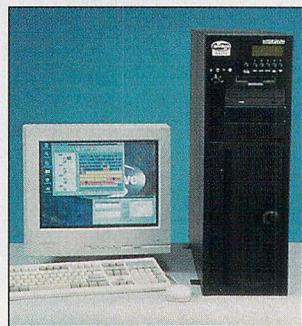
Server Manager offer flexible networking capabilities.

Contact: Micron Electronics, Nampa, ID, 208-893-3434; <http://www.micronpc.com>.

Enter 1016 on Inquiry Card.

Handy New Servers

UTILITY CAN MATTER AS MUCH AS PROCESSORS and capacity in server configurations, so the Intergraph InterServe 650tx and 660tx (from \$24,500) convert from desktop to rack-mountable configurations and include hot-swappable power supplies, RAID subsystems, and redundant fans. The 200-MHz Pentium Pro systems have a base configuration of 64 MB, UltraWide



three-channel raid controllers, 10/100Base-T Ethernet networking, and three 4- or 9-GB UltraWide hot-pluggable hard drives.

Contact: Intergraph Computer Systems, Huntsville, AL, 800-763-0242; <http://www.intergraph.com/ics>. Enter 985 on Inquiry Card.

CD-ROM-Less CD-ROM Servers

A CD-ROM SERVER THAT DOESN'T RELY on multiple CD drives for you to access CD-ROM titles, the SuperCD Sharer instead downloads entire CD-ROMs to a hard drive. A basic configuration, which costs \$2957, has one 12X CD-ROM drive for downloading titles, a ProLInQ controller, and a 4.7-GB hard drive. The SuperCD Sharer supports up to five hard drives; up to 63 CD-ROM titles, depending on configuration; and Token Ring, Ethernet, or 10/100Base-TX Fast Ethernet connections. Axonix says that the server offers transfer rates up to 10 Mbps, an access time of 10 ms, and transfer rates equivalent to 66X.

Contact: Axonix Corp., Salt Lake City, UT, 801-521-9797; <http://www.axonix.com>.

Enter 988 on Inquiry Card.

Printers

Fast, Economical Printing

OKIDATA'S LED PAGE PRINTER, THE OkiPage 6ex, is capable of 6-page-per-minute printing at 600 dpi for



monochrome documents and 600 by 1200 dpi for graphics. Priced at \$569, the OkiPage 6ex has on-board memory from 2 to 34 MB and is compatible with all Windows operating environments.

Contact: *OkiData, Mount Laurel, NJ, 800-654-3282; http://www.okidata.com.*

Enter 983 on Inquiry Card.

Palmtops

Brighter, Smarter, Faster Palmtops

THE LATEST HEWLETT-PACKARD 300 SERIES palmtop PC, the 360LX, offers a higher-contrast screen, more processing power, and more memory than previous-generation HP palmtop systems. It includes direct-printing capabilities, runs Windows CE 2.0, and has a Type II PC Card slot. The 360LX (\$699) includes a 640-by 240-pixel, 80-column screen with white backlighting and 16 shades of gray, 8 MB of ROM and 8 MB of RAM on-board, and a 60-MHz processor.

Contact: *Hewlett-Packard Co., Palo Alto, CA, 800-722-6538*



or 650-857-1501; <http://www.hp.com>. Enter 1015 on Inquiry Card.

Multifunction

Something for Everyone

THE OFFICEJET SERIES 600 MULTIFUNCTION machine (\$599), with its all-in-one scanning, copying, fax, and printing capabilities, could save you a few trips to the copy shop. The latest member of the OfficeJet family prints black text at 5 ppm with 600-by 600-dpi resolution, and at 2 ppm with 600 by 300 dpi in color. It can scan at 1200 dpi and has 24-bit color and 256 shades of gray. It has enough memory on-board to store 65 pages of fax information and transmits at 6 ppm over a built-in 14.4-bps fax modem.

Contact: *Hewlett-Packard Co., Palo Alto, CA, 800-722-6538 or 650-857-1501; http://www.hp.com.*

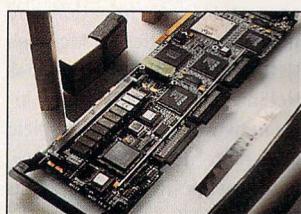
Enter 990 on Inquiry Card.

Add-Ins

TV on a PC

ENERGIZE AN ORDINARY PC WITH 64-BIT 3-D graphics and NTSC/PAL or S-video output. The California Graphics Hawk 3D Pro TV graphics accelerator (\$179), which is based on the S3 VIRGE/GX2 chip, has 4 MB of SGRAM. It delivers 3-D functions such as fogging, bilinear and trilinear filtering, alpha blending, perspective correction, and 30-fps DVD playback with TV output.

Contact: *California Graphics & Peripherals, Inc., Story City, IA, 515-733-5156; http://www.calgraph.com.* Enter 984 on Inquiry Card.

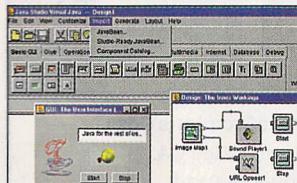


SOFTWARE

Programming

Visual Java

JAVA STUDIO (\$79), FROM SUN MICROSYSTEMS, makes it possible for novice Java programmers to create Java applications and applets without writing code. Developers visually create Java applications by connecting JavaBean components in a graphical environment. The interface has a window for assembling components and a separate window for viewing and testing an application, along with a palette of multimedia functions that automate the production of animation,



sound, text fields, scrolling pages, and other functions.

Contact: *Sun Microsystems, Inc., Palo Alto, CA, 650-960-1300; http://www.sun.com.* Enter 991 on Inquiry Card.

Programming in Tongues

ACCENT'S GLOBAL DEVELOPMENT KIT (FROM \$1500) includes APIs, translation tools, and a multilingual interface for translating software into over 30 different languages. This application keeps a single binary code base, recompiling each version separately. It also automates the translation and resizing of menus, interface strings, message boxes, and dialog boxes.

Contact: *Accent Software International, Ltd., Colorado Springs, CO, 719-576-2610; http://www.accentsoft.com.* Enter 993 on Inquiry Card.

Extend Your Intranet's Capabilities

THE GUIDEWARE SOFTWARE DEVELOPERS KIT (\$349 per developer) is an agent system for integrating Java appli-

cations into corporate intranet and extranet environments. It provides a set of tools, class libraries, and sample code for building sales-automation, help-desk-support, human-resources, and other business applications, which can be integrated into existing applications and environments. The agents interface with applications through ActiveX, JavaBeans, or DLL.

Contact: *Guideware Corp., Fremont, CA, 510-445-0230; http://www.guideware.com.* Enter 992 on Inquiry Card.

Dictation

Smarter Dictation Software

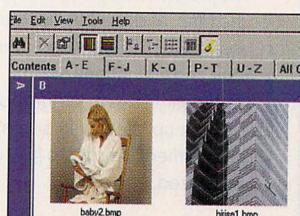
IBM'S VIAVOICE CONTINUOUS-DICTATION software is designed to recognize and adapt to the individual acoustics of different users. It has a vocabulary of 64,000 words and 265 commonly used sentences for recording text into Microsoft Word and other word processing programs. ViaVoice, which costs \$99, requires 125 MB of free hard disk space, 32 MB of RAM (48 MB under Windows NT), and a 166-MHz Pentium processor on a system running Windows 95 or NT.

Contact: *IBM Corp., Somers, NY, 800-426-7080 or 416-383-5152; http://www.software.ibm.com/is/voicetype.* Enter 994 on Inquiry Card.

Storage

Find Files Faster

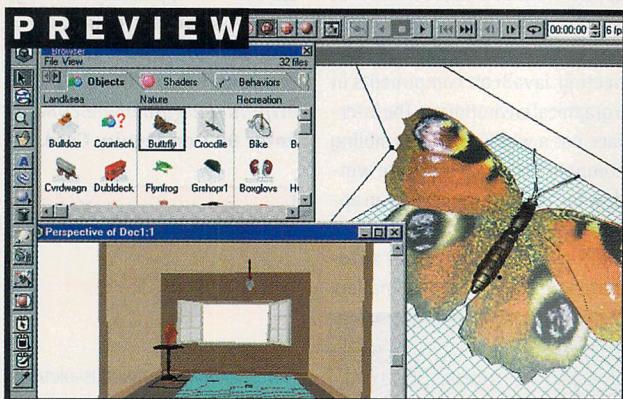
NO MATTER HOW MANY STORAGE DEVICES and disks you use, C:\More, from Citadel Technology, can help locate your files. C:\More (\$79.95) keeps



a catalog of filenames and extracts summaries and keywords from a document every time you save, putting them into a searchable index. The program can also store thumbnails of graphics files for locating graphical images, and it can keep track of changes made to a file on the fly. You simply search for a key-

word or filename or browse through the index of filenames to find an item, and C:\More then tells you the name of the disk that a document is stored on.

Contact: Citadel Technology, Inc., Dallas, TX, 214-520-9292; <http://www.citadel.com>. Enter 995 on Inquiry Card.



Ray Dream 3D
\$99

**Enter 1010
on Inquiry Card.**

MetaCreations Corp.
Scotts Valley, CA
800-846-0111
805-566-6200
<http://www.metacreations.com>

3-D Animation Gets More Accessible

MetaCreations continues to demonstrate a knack for democratizing graphics applications. Goo, Photo Soap, and the new Ray Dream 3D have made special effects, photo editing, and 3-D animation, respectively, available in powerful, affordable, and easy-to-use packages.

Ray Dream 3D is geared for people with some experience using graphics tools. It's easy to use, but it's also more complex and powerful than a typical entry-level graphics application. It uses the same engine as Ray Dream Studio, MetaCreations' professional 3-D package, but with tools and templates that simplify 3-D image creation. Ray Dream 3D also includes modifiable templates, as well as simple drawing tools. Preloaded texture templates make texture mapping easy.

Most basic animation functions are done with drag-and-drop tools. For instance, to make an image spin in space, just drag the Spin icon from the Behaviors palette and specify the rotations per second and the object's axis in the Properties palette, and you have a finished animation. There's a visual time-line interface for more complex animations that offers point-and-click control over light sources, background images, and shading. One nice addition is a tool that gives 3-D images a hand-drawn, rough-hewn look.

The program supports TIFF, DXF, 3DMF, PICT, BMP, QuickTime for the Mac, and the AVI file format for Windows machines. It also supports GIF, JPEG, VRML, and RealSpace formats for posting images and animations on-line.

Ray Dream 3D is a potent application, making it possible for novices to jazz up Web sites or presentations. However, you need to first experiment in order to fully understand how it works and how it's organized.

-J. K. K.

Management

A Network Usher

IT MAY NOT BE POSSIBLE TO MICROMANAGE your network traffic if it begins to overwhelm the available bandwidth. Check Point's FloodGate-1 (from \$4995 for dial-up lines) can maintain state-related data on all communications for intelligently queuing and managing communications. It applies a hierarchical algorithm to allocate bandwidth for network traffic, ensuring that even low-level functions receive bandwidth on a consistent basis, and it allows managers to assign priorities to different functions.

Contact: Check Point Software Technologies, Inc., Redwood City, CA, 415-482-4900; <http://www.checkpoint.com>. Enter 996 on Inquiry Card.

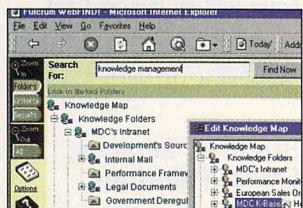
and management, includes a database of 5000 well-known applications for inventory management, a bundled SQL database engine, support for new cards, increased speed, and a redesigned user interface. The program, which enables you to distribute software via a push or pull installation (with a pull installation, the end user selects available software packages from a dynamically built list of options), costs less than \$50 per desktop.

Contact: PalmSun Software, Inc., Austin, TX, 512-322-5330; <http://www.palmsun.com>. Enter 1013 on Inquiry Card.

Intranets

Get to Know Your Net

THE FULCRUM KNOWLEDGE NETWORK creates a single access source for both intranet and Internet data. It can read a variety of text and binary for-



mats, navigate Microsoft Exchange and Lotus Notes/Domino message stores, and use ODBC to go into a variety of databases. Point it at a document source (e.g., Notes, Exchange, a Web site, a file share, or an ODBC data source), and it indexes it. The program starts at \$85 per user and has a new Web crawler and a customizable directory.

Contact: Fulcrum, Ottawa, Ontario, Canada, 613-238-1761; <http://www.fulcrum.com>. Enter 999 on Inquiry Card.

Keep Tabs on Your Intranet

DOCUSHARE AUTOMATES POSTING, VIEWING, cataloging, and searching for documents on a corporate intranet. The package, which costs \$995 for 50 users and \$495 for each additional 25 users, does not require

Cooler Desktop Management

KEEPCOOL 3.1, A WINDOWS PC DESKTOP-management suite for remote software distribution, software/hardware inventory, and configuration

employees to have any knowledge of HTML to be able to post documents. The program keeps track of all changes made to documents and can support over 40 proprietary file formats, including Microsoft Word, RTF, WordPerfect, and standard file

formats. It can also execute compiled programs.

Contact: Xerox Corp., Palo Alto, CA, 800-428-2995; <http://www.xerox.com/products/docushare>.

Enter 1000 on Inquiry Card.

Software Updates

Symantec sells three Java development tools: Café, Visual Café, and Visual Café Pro. A new version merges them into one basic tool called **Visual Café 2.0 for Java**, which comes in three editions. Added features include native compilation for x86, support for JDK 1.1, JavaBeans, JFC libraries, and incremental debugging. Visual Café 2.0 Web Development Edition (\$99) is for Java novices and applet developers. It includes Symantec's Visual Page HTML editor, Netscape Communicator 4.0, and a Java programming book. Visual Café 2.0 Professional Development Edition (\$299) is for professional applet and application developers. It also includes Visual Page and Communicator and has some additional features, including a faster compiler, native compilation to x86 code, and the ability to incrementally debug applets inside Communicator and to debug ZIP/JAR archives. Visual Café 2.0 Database Development Edition (\$499) is for professional database developers. It includes Visual Page, Netscape's Fast-Track Server, JavaBeans dbAware components, JDBC support in db-Anywhere, and all the features of the Professional Edition.

Contact: Symantec Corp., Cupertino, CA, 408-253-9600; <http://www.symantec.com>.

Enter 1004 on Inquiry Card.

Symantec is bolstering its line of crash-protection and uninstaller products with two new releases, **Norton Uninstall Deluxe** and **Norton CrashGuard Deluxe**. CrashGuard Deluxe offers crash protection as well as recovery functions following a failure. Priced at \$49.95, it detects and fixes problems with an Auto Check feature; with the LiveUpdate Pro Web-based service, new drivers, patches, and virus-protection updates are automatically uploaded to your system. Uninstall Deluxe (\$39.95) can restore overwritten files with a feature called InstallGuard.

Contact: Symantec Corp., Cupertino, CA, 408-253-9600; <http://www.symantec.com>.

Enter 1005 on Inquiry Card.

The **BackOffice Small Business Edition Server 4.0** from Microsoft (from \$800) is designed to fit the needs of companies with 25 or fewer systems and/or 100 employees. New, central features in this small-business release include a fax server, modem-pooling capabilities, and a wizard for setting up local or national accounts with Internet service providers. The package also includes Windows NT Server 4.0, Internet Information Server 3.0, and Microsoft SQL Server 6.5 for file, printing, and application functions, as well as communications applications, including Exchange 5.0, Outlook 97, and Microsoft's fax server. The Microsoft Proxy Server opens a secure gateway to the Internet, and FrontPage 97 helps you take your business on-line.

Contact: Microsoft Corp., Redmond, WA, 800-426-9400 or 206-882-8080; <http://www.microsoft.com>.

Enter 1006 on Inquiry Card.

Deploy a Secure Intranet

THE INTRA.DOC MANAGEMENT SYSTEM controls the deployment of information across intranet, extranet, and Internet Web sites. The system builds secure business libraries with check-in/check-out control, revision control, and automated publishing in Web-ready formats. Intra.doc costs \$17,995 per server for an unlimited number of clients to view documents. The package stores documents in their native formats and generates HTML links and menus according to Web-site structure.

Contact: IntraNet Solutions, Inc., Eden Prairie, MN, 612-903-2000; <http://www.intranetsol.com>.

Enter 1001 on Inquiry Card.

Scanning

Better OCR from ScanSoft

SCANSOFT'S TEXTBRIDGE PRO 98 OFFERS improved accuracy and compatibility with existing applications, plus easier operation for novice OCR users. The Windows program lets you convert scanned paper documents or faxes into editable documents that duplicate the page layout of the original. It also lets you convert ruled or unruled tables into spreadsheets or word processing documents, so tables are embedded within a document; thus, you can edit while retaining the original format. Version 98 is up to 82 percent more accurate than previous versions, the company claims, and it now recognizes elements such as drop caps, reversed text, insets, and line art. In addition, you can proofread and edit directly in TextBridge. A new Wizard guides novices through the OCR process, and you can use the \$79 program directly within many popular Windows 95 applications.

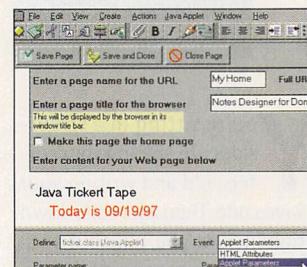
Contact: Xerox ScanSoft, Inc., Peabody, MA, 978-977-2000; <http://www.textbridge.com>.

Enter 1012 on Inquiry Card.

The Web

Web Development for Domino

LOTUS'S NOTES DESIGNER FOR DOMINO 4.6 is an application-development tool for designing Web-based applica-



tions for the Domino 4.6 server. It gives developers direct access to Domino folders; supports Java servers, agents, ActiveX components, and applets; and includes templates for jump-starting the design process. Designer (\$495) includes Lotus Bean-Machine, for writing Java applets, and Notes Global Designer, which creates multilingual versions of Notes applications.

Contact: Lotus Development Corp., Cambridge, MA, 617-577-8500; <http://www.lotus.com>.

Enter 998 on Inquiry Card.

E-Mail

Drowning in E-Mail?

THE INTERNET MESSAGE CENTER (\$1500) helps companies that are swamped by e-mail requests sent to salespeople, help desks, or other on-line services. It sends a form letter to confirm the receipt of a message, assigns every message a tracking number, and routes incoming messages to the appropriate representative(s). The package works with any POP3 client and stores data in ODBC databases to keep track of the pool of unanswered mail and to create a record of all incoming and outgoing messages.

Contact: Mustang Software, Inc., Bakersfield, CA, 805-873-2500; <http://www.mustang.com>.

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Improbable

A new toy wreaks revenge on the overtalkative wireless generation.

Advances and Retreats in Computing

You're sitting in a street-side café, sipping your coffee cold and writing your Java code. Then a jerk sits down right next to you, pulls out a cell phone, punches some buttons, and begins yacking at the top of his lungs. You want to kill him, of course. But might there be a better, less directly homicidal way to solve the problem?

A new product, called "Apoptosis," might be exactly what you need, and it should arrive

CELL DEATH

WormWare Productions, the same outfit whose popular Stochastic Cleaner software was recently chronicled in this column. Like all WormWare products, Apoptosis costs \$4.95.

What's so wonderful about Apoptosis? Simply this: It disconnects any cell-phone call within earshot of you. Apopto-

gab, gab on a cell phone, you simply adopt an innocent facial expression, squeeze your little "worry bead," and instantly see your wish come true: The jerk's cell-phone connection dies.

True, this product is the subject of various lawsuits, but they won't go anywhere. The telecommunications companies

squirted Jolt Cola instead of water. The total bill for the day ran in excess of \$26.2 million, and most of it was charged to "Corporate R&D." Such hubris, such corporate hoings, surely bode ill for what was once such an innocent-and wholesome-industry.



Lament for Nano-Programmers

Our psychological profile of nano-programmers inspired this plaintive note from a director of software engineering: "It is said that nano-programming requires a different mind-set than anything that came before it. Our experience bears this out. All our nano-programmers are under the age of 9. They drink enormous quantities of soft drinks, and they pull down an average salary of \$370,000 a year. If you think their income seems outrageously high, keep in mind that their skills will become obsolete before they reach high school."

Techno-Styles of the Rich & Famous

Many West Coast techno-millionaires spend their time looking for conspicuous ways to flaunt their wealth. The latest in profligate spending is called "Failure Mode Sprints" (FMS). On the first Thursday of every other month, the techno-gilded geekillionaires buy all the latest hardware and gather to stage a competition. They measure how long (in nanoseconds) various systems run after a fire hose is trained on them. At last month's FMS event, the hoses

just in time for the holidays. The word "apoptosis" comes from biology: It means "programmed cell death." (Biologists have found that many cells are "programmed" by their DNA to die after some particular span of life.) Apoptosis—the product—is a new piece of hardware from

sis has an effective range of 15 feet—wide enough to get the job done, tight enough that it won't disrupt the phone connections of innocent neighbors.

Apoptosis is small and inconspicuous. It fits on a keychain. It looks like a worry bead. When someone nearby starts to gab,



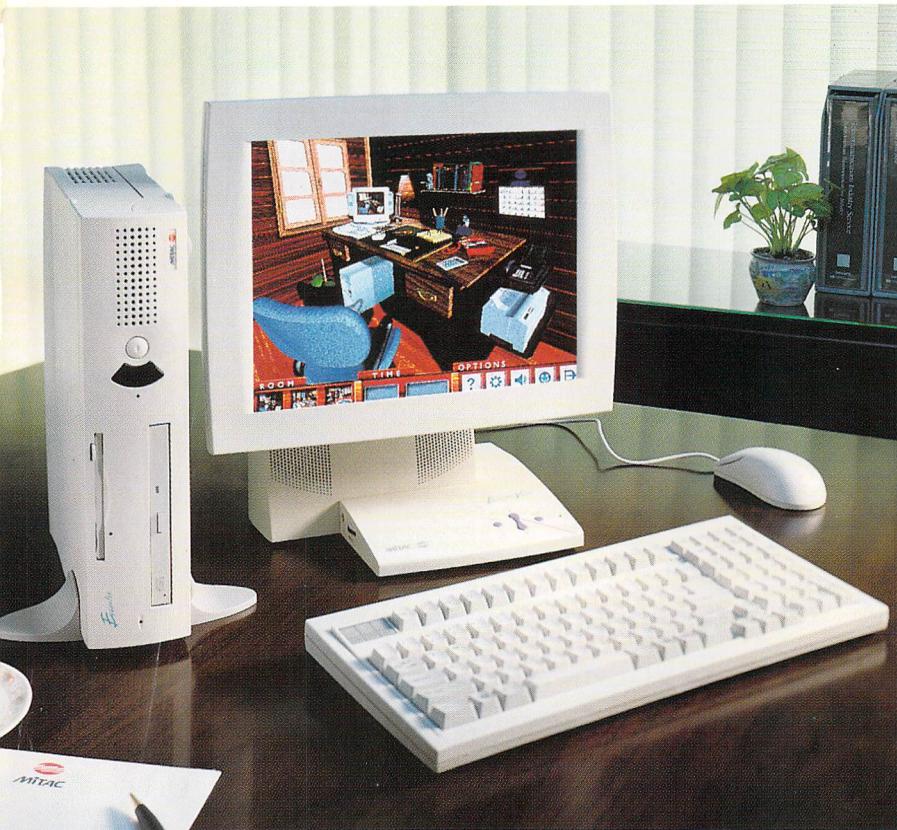
love Apoptosis. Each broken connection means that yet another call will be placed, racking up

yet another lovely (from a telephone company's point of view) connect charge. The telecommunications industry is already making billions from this humble product. Look for it to keep putting up token legal protests for the sake of looking like a "responsible corporate citizen." But don't expect it to press even a single case toward completion.

What's our final verdict on Apoptosis? Thumbs up, big-time. It benefits the common man and costs just \$4.95. And it's so satisfying—your neighbor's irritating conversations will end never with a bang, but always with a frustrated whimper.

Marc Abrahams is the editor of the Annals of Improbable Research. You can contact him by sending e-mail to marca@improb.com.

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Looking for OEM/Distributors



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